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Vol. 83, No. 1

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April 1986 Rs. 90

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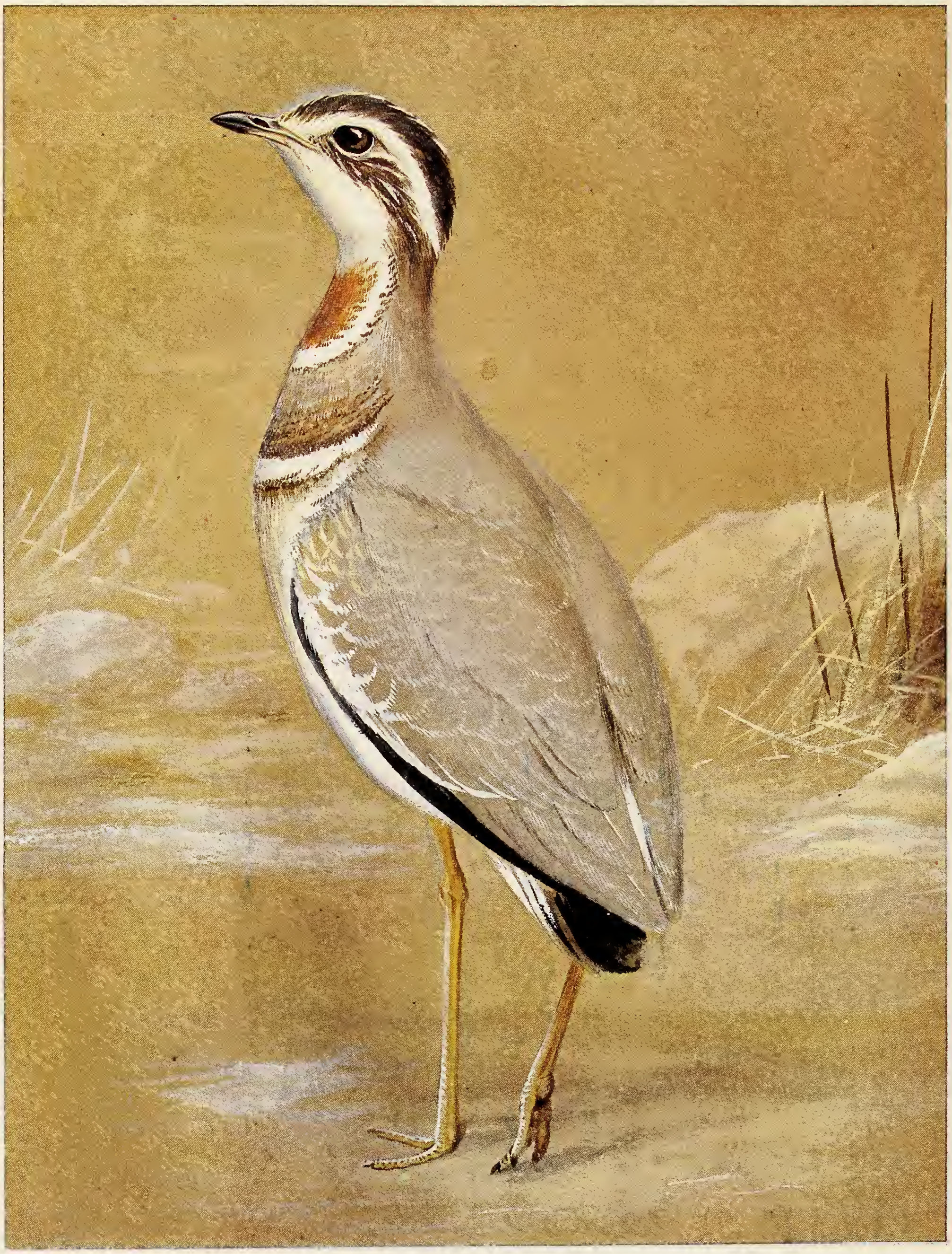

Jerdon's or Double-banded Courser *Cursorius bitorquatus* (Blyth).

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REDISCOVERY OF THE JERDON'S OR DOUBLE-BANDED COURSER *CURSORIUS BITORQUATUS* (BLYTH)[1]

Bharat Bhushan[2]

(*With a colour plate & a text-figure*)

The Jerdon's or Double-banded Courser *Cursorius bitorquatus*, last recorded in 1900, is one of the rarest avian species in the world. Lack of subsequent records led to the presumption that the species may be extinct. Surveys carried out in 1985-86 finally established the presence of the species in Cuddapah district of Andhra Pradesh.

INTRODUCTION

The Jerdon's or Double-banded Courser *Cursorius bitorquatus* (Blyth) was first "procured" and recorded for science by Dr. T. C. Jerdon (Blyth 1848) in *c.* 1848 "from the hilly country above the Eastern Ghats, off Nellore, and in Cuddapah" (Jerdon 1877). Blanford (1898) recorded the Double-banded Courser in March 1871 near Sironcha and Bhadrachalam near the Godavari river-valley in northern Andhra Pradesh. The last "presumably authentic sighting" was by Howard Campbell in 1900 in the Pennar river valley near Anantapur (Ali 1977).

The 1900 record near Anantapur being the last, led to the Double-banded Courser being considered as one of the rarest avian species in the world.

Jerdon (1877) on the basis of his bird surveys in the Eastern Ghat areas in southern Andhra Pradesh remarked that he believed the Double-banded Courser to be a "permanent resident" and an "almost unique instance of a species of Plover having such an extremely limited geographical distribution". The lack of sightings subsequent to Blanford (1898) and Campbell (Ali 1977), indicates that the Double-banded Courser is known only "from a restricted area in eastern India, from the

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valley of the Godavari river, near Sironcha and Bhadrachalam, and from Nellore, Cuddapah and Anantapur in the valley of the Pennar river" (Greenway 1958, Ali and Ripley 1969).

Whistler and Kinnear (1930) during the ornithological survey of the Eastern Ghats (in 1929-31) and Ali (1933-34) during his Hyderabad State Ornithological Survey (in 1931-32) had covered the known range of the Jerdon's Courser "pretty thoroughly" without success. Later, two "special explorations" organized by the Bombay Natural History Society in 1975 and 1976 with the collaboration of Smithsonian Institution and World Wildlife Fund-India respectively did not achieve positive results (Ali 1977). A poster prepared for the Society by J P Irani showing the Jerdon's with the Indian Courser in colour, was circulated in Andhra Pradesh and adjoining States during these years without eliciting any positive response.

This continual failure to record the Double-banded Courser resulted in several authors (Ripley 1952, 1961, Howard and Moore 1980, Walters 1980, King 1981) listing the species as either extinct or thought to be as such. The possibility of this truly peninsular endemic becoming extinct was very improbable considering the vastness of potentially suitable habitat in the lower peninsula. As results from this Study show, the effort to search out the Double-banded Courser had been "too little" (Ali & Ripley 1985).

SURVEY

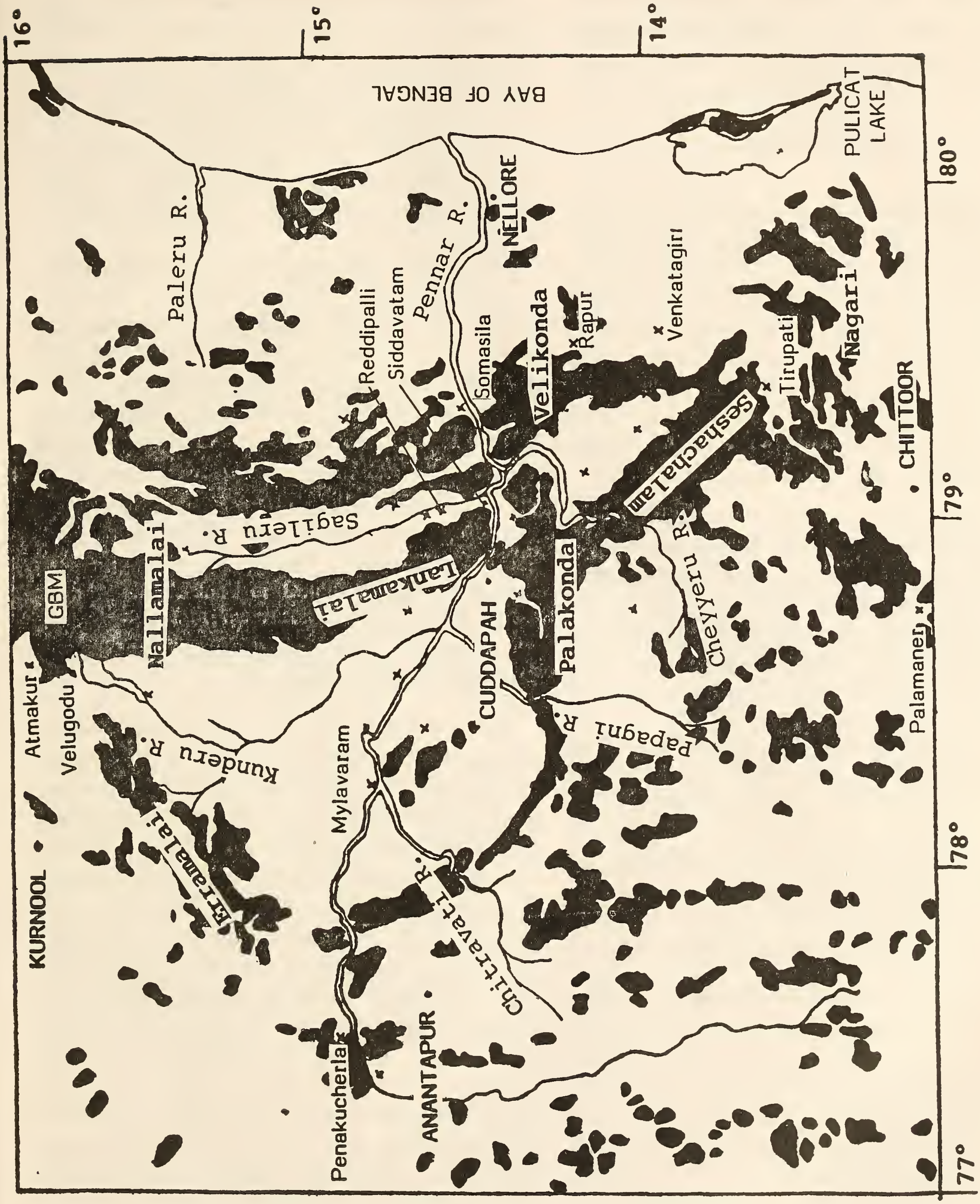
The Bombay Natural History Society under the aegis of its research project — 'Study of the Ecology of Rare and Endangered Species of Wildlife and their Habitat', funded by the Fish & Wildlife Service, USA, through the Department of Environment, Government of India — decided in May 1985 to survey the Pennar river valley areas in southern Andhra Pradesh and try to establish whether the Double-banded Courser is still present or extinct in these areas.

Towards this end, a preliminary survey (Bhushan 1985a) was carried out over the Pennar river-course and its adjoins (9th-16th, 23rd-24th June and 2nd-4th July 1985). Based on results from the preliminary survey, spot-survey locations were decided upon and conducted (Bhushan 1985b) at Somasila in Nellore district and at Siddavatam in Cuddapah district (5th-6th and 12th September to 5th October 1985; 12th-27th January and 3rd-6th February 1986).

Jerdon had mentioned the "hilly country above the Eastern Ghats, off Nellore, and in Cuddapah" and Campbell had sighted the Courser in the Pennar river valley areas near Anantapur. Since the Pennar river flows through Cuddapah and Nellore before flowing into the Bay of Bengal, the river-course was to be considered as the first term of reference.

The next point to be determined was the habitat-type in which to locate the Double-banded Courser. Found to inhabit "rocky and undulating ground with thin forest jungle", Jerdon (1877) believed the Double-banded Courser to be a "mountain form of *Cursorius*, frequenting rocky hills with thin jungle". Blanford (1898) recorded the species "in thin forest or high scrub, never in open ground". He "never saw any on hills", in contrast to Jerdon's belief.

Thus, going by their descriptions of the habitat-types, the Double-banded Courser would be inhabiting areas totally unlike those favoured by the Indian Courser. The survey


16°
15°
14°
BAY OF BENGAL
PULICAT LAKE
80°
79°
78°
77°
Paleru R.
Pennar R.
NELLORE
Venkatagiri
Rapur
Velikonda
Somasila
Siddavatam
Reddipalli
Tirupati
Nagari
CHITTOOR
Seshachalam
Sagileru R.
Nallamalai
GBM
Lankamalai
Palakonda
Cheyyeru R.
CUDDAPAH
Atmakur
Velugodu
Kunderu R.
Papagni R.
Palamaner
Mylavaram
Erramalai
KURNOOL
Chitravati R.
ANANTAPUR
Penakucherla

SOURCE : FOREST ATLAS MADRAS PLATE 12

SCALE : 1 : 1,000,000

Fig. 1. The Pennar river valley areas in the Eastern Ghats complex of southern Andhra Pradesh.

had to locate hilly and low undulating ground near the Pennar river or better still comprising valley areas over the river's course through the three districts. (see Fig. 1).

METHODOLOGY

The BNHS had used a poster from a colour painting by J. P. Irani showing both the Jerdon's and Indian Courser. This had been distributed along with a descriptive note written in English for Andhra Pradesh and adjoining states for feedback. The most obvious error here was the absence of a Telugu note for the Pennar river-valley areas. The Godavari river-valley areas would require notes in the Telugu, Marathi, Oriya and Urdu languages.

This error was rectified by having the English note translated into Telugu and xeroxed along with the colour plate. One hundred copies were distributed personally by me to only concerned individuals like Forest Officials, local shikaris and tribals proficient in bird-trapping.

The second visual aid used for cross-examining locals was the PICTORIAL GUIDE TO BIRDS OF THE INDIAN SUB-CONTINENT by Ali & Ripley (1983). This was used to verify the local informants' depth of knowledge; his ability to distinguish different birds at a glance; and, the ability to describe each bird that he identified coupled with a local logical name.

The enquiries were followed up by walking about in the area, listing the birds seen and deciding if it would be the correct habitat-type for the Double-banded Courser. This was alternated by examining the area from a convenient point using a spotterscope for scanning. Equipment used included a 12 x 50 Binoculars and a spotterscope of 10 x magnification.

Bhushan (1985a & b) has described the preliminary survey and spot-surveys in detail. From the number of enquiries made during these surveys, three shikaris gave three versions of what may be the Jerdon's or Double-banded Courser. Of these three versions, an account of the Siddavatam locality — which turned out to be correct — is given below.

THE SIDDAVATAM AREA: CUDDAPAH DISTRICT

The Lankamalai ranges at Siddavatam are about 20 km from Cuddapah. From Siddavatam, the hills range north towards the Nallamalais at Nandyal (in Kurnool district) and south to the Palakondas at Vontimitta and to Tirupati (in Chittoor district). Eleven kilometres from Cuddapah towards Siddavatam, the slopes are gentle and all the hills have scrub vegetation. This type of apparently suitable vegetation/habitat (to the Double-banded Courser) continues to Siddavatam along the foothills. The Pennar river flows along the Siddavatam settlement.

With the help of the local (Siddavatam) Forest Range Officer, I met a small-game 'vetagadu' (=shikari) named Aitanna residing at Reddipalli village, 12 km from Siddavatam. He could not recognise the Double-banded Courser, but said he knew the Lesser Florican *Sypheotides indica,* known here as 'nela nemili' (nela = ground; nemili = peafowl), which was seen only in the rains. Some of the other villagers standing around, could also recognise the Lesser Florican from the 'Pictorial Guide'. Aitanna later informed me of the presence of an experienced Yaanadi (= name of a tribe, that used to depend partly on shikar as subsistence; now settled in exclusive settlements or at village-adjuncts) tribal named Pichchanna, at Kumbagiri village, about 12 km after Reddipalli, between Siddavatam and Badvel.

Pichchanna recognised the Double-banded Courser from the poster and said that it was known as 'Kalivi-kodi'. The word 'Kalivi' is the Telugu word for *Carissa* which is the common scrub vegetation along with *Zizyphus* and *Acacia* in the area. 'Kodi' means fowl. According to Pichchanna, the name 'Kalivi-kodi' was an apt description for the bird on account of its habit of hiding amidst the thorny *Carissa* bushes.

The *Carissa* grows to about 2-3 metres in height in the reserve forest areas on the foothills of the Lankamalai, whereas in the revenue areas, i.e., non-protected areas below the range-demarcation line towards Kumbagiri, the *Carissa* is shorter, about 1-2 m tall. Also due to over browsing, *Carissa* in the revenue areas grows horizontally in some spots at an height of about 50 cm from the ground. It was next to these low *Carissa* bushes that Pichchanna had seen the Kalivi-kodi and not under taller ones.

According to Pichchanna, the Kalivi-kodi is 'just a bit' larger than the Grey Partridge *Francolinus pondicerianus,* and mainly seen during the rainy season and is difficult to spot. When disturbed, the Kalivi-kodi walks for 'some distance' stops and flies away to a nearby spot. He has always seen them in flocks of 7-8 birds, never seen them in cultivation, near artesian wells or near other water-areas. He described the call as to be 'very sad'; a single note and very soft.

He has always seen the birds only during the rainy season in the plain-foothills, exploited-scrub areas after the range demarcation line (on the foothills), and presumes that it may be seen on the hills. It was 'many' years since he stopped shikar (This statement may have been due to the presence of the Forest Range Officer with me) and could not pinpoint any location in the hills, but could take me around in the foothill scrub areas after the monsoon started.

Pichchanna knew birds well and said he could identify them in the field separately. He could identify and describe the habits of partridge, sandgrouse, lapwings (here known as 'utha-titti' (!), 'uththithi' and also as 'Uththuthagaadu' at Chittapalli village; — meaning 'stammerer'), Lesser Florican (which he claims to have trapped a number of times 'a long time back') and Grey Jungle Fowl *Gallus sonneratii.*

The name 'thiththi' may phonetically correspond to the 'Adavi-wuta-titti' mentioned by Jerdon (1877) as being the Telugu name of the Double-banded Courser, supposedly meaning 'Jungle-empty-purse'. Ali and Ripley (1969) mention that the name is not current and/or locally understood. Obviously, the name must have meant 'Forest Lapwing' (Adavi = Forest), and not the literal translation that Jerdon claimed.

I visited the Siddavatam area again in October 1985 and contacted Pichchanna at Kumbaviri village. His information was not very helpful. He maintained that his meagre financial resources over the past few months had prevented him from indulging in shikar/bird-trapping on the hills.

Aitanna at Reddipalli village was very encouraging. During the preliminary survey he had disclaimed knowledge of the Double-banded Courser. This time however, he claimed to have kept a watch during his shikar trips and had sighted the Kalivi-kodi a number of times in the scrub forests, below the Lankamalai hills. He claimed that he sighted the birds in the night when out hunting with powerful torches. He insisted that the bird was seen to be feeding normally at night.

During the period of my stay in October 1985 at Siddavatam and Somasila, there were heavy rains and a dense cloud-cover present on the hill-slopes. Aitanna refused to search for the bird in the night with the flashlight as the equipment would be useless in the rains. With the cloud-cover on the slopes, there would be no visibility at all. These areas were then decided to be surveyed in detail during December 1985 to January 1986.

DISCUSSION

Having come to know first-hand the possible locations of the Double-banded Courser along the Pennar river, and having got three presumptive descriptions of the species, the next step had to be towards minimising field-effort towards procuring a definite record. Naturally, this would depend on the presumptive descriptions.

The claims by local people about the Double-banded Courser could not be cross-checked with literature on the species as the recorded information (Jerdon 1877, Blanford 1898) lacked in detail vis-a-vis the specific location/s and the biology. Since the congeneric under Ripley's (1961) listing, *Cursorius coromandelicus* prefers "dry stony plains and fallow fields" unlike the *C. bitorquatus* (as recorded by Jerdon and Blanford), I decided to check on congenerics under *Rhinoptilus* as listed by Howard and Moore (1980) for the Double-banded Courser.

Peters (1934), Howard and Moore (1980) and Walters (1980) classify the Jerdon's or Double-banded Courser as *Rhinoptilus bitorquatus*. The congenerics of the Double-banded Courser according to their 'Checklist's are the Two-banded Courser *R. africanus*, Heuglin's Courser *R. cinctus* and the Bronze-winged Courser *R. chalcopterus*. Presuming that congenerics would have some similar behavioural characteristics, interesting points about the three African *Rhinoptilus* that were thought to be pertinent when compared to my survey results is tabulated (Bannermann 1931, 1951, Mackworth-Praed and Grant 1952) (Table 1).

Taking into consideration the congenerics' descriptions, and comparing them to survey records, the Double-banded Courser was thought to be (in December 1985): Found in thorn scrub country; similar in field-appearance to the lapwings; ground nesting bird with no nest-building; resting during the day under shade of a thorn tree; uncommon in areas of distribution-range and also able to evade observation successfully; and, crepuscular and/or nocturnal in habit. These points were to be regarded as a 'reference frame' for future surveys.

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Following the two surveys and comparisons of congenerics in literature (mentioned above), I decided to leave aside the Anantapur and Nellore areas. Ali (1977) had claimed the Anantapur record to be only a "presumably authentic sighting", and the Nellore areas at Somasila had very high disturbance levels to the local fauna due to the Telugu Ganga Canal working (Bhushan 1985b).

The probable claim of knowing the bird at Cuddapah was from the Yaanadi Pichchanna at Kumbagiri village and Aitanna at Reddipalli village in the Siddavatam area. Before these

Table 1

Comparison between *Rhinoptilus* spp. (as classified in Howard & Moore 1980)

R. bitorquatus	*R. africanus*	*R. cinctus*	*R. chalcopterus*
Prefers scrub with thin forest.	Birds of rocky thorn scrub country, sandy plains and salt-deserts.	Rarely found away from thick thorn scrub.	Prefers bush-covered country/woodland in some areas.
?	Not common anywhere, scattered over wide areas.	—	Evades observation successfully even if present in the area in any numbers/ uncommon in many places.
Hides/rests amongst thorn scrub bushes like *Carissa* during the day; when disturbed, walks for 'some' distance, stops and takes to flight.	Resting by day in the shade of a thorn tree; prefer to run and take to flight only when approached near.	—	Found to be nearly stationary under bushes during the heat of the day; not easily seen when motionless, and takes to air only when approached near.
May be crepuscular and/ or Nocturnal (local enquiries).	—	Largely Nocturnal.	Nocturnal in habit ("this may account for the paucity of records") /crepuscular.

claims could be investigated in detail, justification had to be sought from records in literature. Cuddapah had been mentioned only by Jerdon (1877).

First, I had to decide whether the Lankamalai ranges of the Eastern Ghats complex was in confirmation with Jerdon's geographical pointer. Second, was the question, as to whether the Yaanadi tribals, my contacts in the Cuddapah and Nellore areas, were ever contacted by Jerdon during his surveys in the Eastern Ghats.

Elliot (1873) in his biography of T. C. Jerdon, lists the latter's army postings in detail. He states that (that Jerdon had): "... an opportunity of seeing a part of the country difficult of access and rarely visited; and he did not neglect it, as his notices of the birds of the Eastern Ghats subsequently showed."

"After passing about four years with his regiment, he obtained leave of absence to visit the Nilgiri hills, where he was married in July 1841. Six months afterwards, he was appointed Civil Surgeon of Nellore..."

"The wilder parts of the country between Madras and Nellore are occupied by the Yaanadis, a remarkable aboriginal tribe, of seminomad habits, subsisting on the spontaneous produce of the jungles, and possessing in consequence a minute acquaintance with the forms of animal and vegetable life around them. By their means Dr Jerdon discovered many new species, . . .”

Having thus been proved by Jerdon’s biography that I was on the right track, as regards the Yaanadis, there still remained the first point about the geographical location to be decided upon. Jerdon (1877) had claimed of procuring the bird “in the hilly regions above the Eastern Ghats, off Nellore and in Cuddapah”.

The Eastern Ghats at Cuddapah are the Velikonda ranges running north/north-easterly from Tirupati. The other ranges, the Seshachalams, Palakondas, Nagari, Lankamalai, Nallamalais, and Erramalais together with the Velikondas form the Eastern Ghats complex in southern Andhra Pradesh.

The Velikonda ranges, if regarded as the “Eastern Ghats”, cancelled out the Nellore district as any area for survey. Jerdon had mentioned “off Nellore” and the Velikondas were the district boundary between Nellore and Cuddapah. The subsequent mention, “and in Cuddapah” would then obviously mean a location in that district.

The only point that confused me was the mentioned of “hilly regions above the Eastern Ghats”. Jerdon had been posted at Nellore. From the Nellore city, any hills/hill-ranges west of the Velikondas could be hilly regions “above” the Eastern Ghats if Jerdon had generalised in describing the location. Thus, the “hilly regions” would be either the Palakondas or the Lankamalai hills.

Taking into consideration — (1) the proximity of the Pennar river to the Lankamalai rather than the Palakondas, (2) Pichchanna, an experienced aged Yaanadi bird-trapper, who described the ‘Kalivi-kodi’, (3) Aitanna, who though not a Yaanadi had confirmed that the ‘Kalivi-kodi’ could be the Double-banded Courser by having examined it closely with his powerful torchlight, (4) the mention of the *Rhinoptilus* spp. being nocturnal/crepuscular in habit being confirmed by Aitanna for the ‘Kalivi-kodi’, and (5) the presence of the correct habitat-types in the areas specified by Pichchanna and Aitanna, — I decided to once again contact Aitanna, who being a “nocturnal” shikari, was the only possible hope of enabling me to see the Double-banded Courser with minimal effort.

The survey had to be put off in late December 1985 as planned due to heavy rains. Aitanna had refused to go out during rains in October 1985. The rains subsided by the first week of January 1986. I wrote to Aitanna from Palamaner (in Chittoor district of Andhra Pradesh where I was helping Mr. Sivaganesan, field biologist of the Society in our study of an elephant herd which had entered the State) asking him to keep a watch for the ‘Kalivi-kodi’ and point out the locations for me when I would arrive.

Travelling on 12th January by motorcycle from Palamaner, I reached Vontimitta, a village situated in the Palakondas south of the Pennar river. Deciding to set up camp at the Vontimitta Forest Rest House, I stayed there overnight. There were no rain clouds in the night. According to local forest department officials, it had not rained since the previous night. I was getting hopeful. But, the unexpected happened !

Aitanna had gone out that night (12th January) with his colleagues for his regular shikar as usual. He claimed to have been seeing the ‘Kalivi-kodi’ at a particular area in the 'foothill-scrub' over the past few days. He had been going there daily to check their presence. His main shikar quarry was the Grey Partridge and the Hare *Lepus nigricollis.*

This time, according to him, just before the 'Kalivi-kodi' spot, they flushed some partridges. The partridges rose swiftly over the scrub-line and kept flying low towards the hills. While they had their torchlights focussed on the flying birds, Aitanna heard some slight noise in a nearby bush (*c.* 20 cm tall/approx. time = 0130 hours). Lowering his torchlight, he saw a 'Kalivi-kodi' standing there confused and motionless in the torch-beam. Before the bird could react, Aitanna ran up to it and in the same continuing motion, picked up the bird in his hand.

He brought the bird back to Reddipalli village and kept it in his house. It started raining soon after this incident by early dawn and continued drizzling steadily on 13th January. Not knowing about the capture, I went ahead to Cuddapah and contacted the Divisional Forest Officer, Mr Yusuf Sharif, to make arrangements for the survey. The Siddavatam Range Officer informed me that Aitanna had caught some 'nela nemili' on the previous night at Reddipalli.

'Nela nemili' being a Telugu word for the Lesser Florican, was a highly improbable capture for a nocturnal shikari who works with torchlights. I returned to Vontimitta without going to Siddavatam as it had started raining heavily and one had to cross the Pennar river on a low causeway that got easily submerged at such times.

It rained heavily throughout the 14th of January making it impossible for me to travel on the motorcycle. With the help of a local villager, I managed to send a message to Aitanna at Reddipalli by a local bus about my arrival. Late at night, the bus-driver on his return journey informed the rest-house watchman that Aitanna had caught 'some' bird and wanted my presence in the village as soon as possible.

I started early on the 15th January and rode the motorcycle in the rain to Siddavatam. The Pennar was flowing above the bridge at two spots and the Siddavatam roads were in a total mess. I reached Reddipalli by 0800 hours and went to Aitanna's house. He bade me sit and went inside to fetch the bird.

He brought the bird in his hand. There was no disturbed movement from the bird. Its legs were dangling from between his fingers. Aitanna had tied string to its legs. The neck was low, and only the top of the head could be seen.

I had not been hoping to see the Jerdon's Courser so easily. Even with the bird in his hand, it did not strike me that it could be the same. The coronal streak was not clearly visible. The Black crown and the grey upper plumage was all that was visible. The pale fleshy yellow legs had no hallux. Apart from this, I was about to decide to myself that it may be some other species when the bird raised its head and stretched its neck. And, there it was !

The broad white supercilium, the white throat with a broad rufuous band below, followed by the narrow white semi-collar with a broad brown "gorget" below. Lifting Aitanna's hand, I could see the white collar "margined above and below with dusky" below the brown gorget. There was a faint white mesial line in the centre of the black crown. Now there was no doubt.

Thus, finally after 86 years, was the Jerdon's or Double-banded Courser, locally known here as the Kalivi-kodi, rediscovered.

The bird was not struggling at all in his hands. Aitanna had been keeping Grey Partridges and claimed knowledge of handling birds. He informed that he had been feeding the bird some powdered rice along with termites and black ants.

Asking him to keep the bird with him in safe custody, I rushed to Cuddapah and informed the Divisional Forest Officer. By 1330 hrs, I had informed the Curator, BNHS, Mr J. C. Daniel. He informed Dr Sálim Ali who wished to see the bird for himself. I saw the bird again on 16th January. It was fine and accepting the ants and termites being given to it by Aitanna as claimed by him. Informing him of Dr Sálim Ali's pending visit, I went to Tirupati on the same day. Dr Sálim Ali and Mr P. B. Shekar arrived at Tirupati on 19th January and reached Reddipalli, but were too late to see the bird alive. The bird died barely 4-6 hours before we could reach (1800 hours) the village. Aitanna was the saddest of us all.

Dr Sálim Ali expressed surprise at the easy method of capture as described by Aitanna. He asked the shikari if I could try with the later to capture another individual on the same night. Aitanna agreed for the attempt and asked me to reach the village by 2100/2200 hours.

Aitanna's method of capture needs recording here. He was not a "nocturnal" shikari earlier, having then preferred to use a gun. About five years ago, a bird-trapper had arrived at Reddipalli from Venkatagiri in Nellore district. This trapper had used the modified torchlights and the method was learnt by Aitanna and his colleagues while accompanying him.

The equipment consisted of a four-cell metal tubular torchlight. The cells had been removed. The contacts for the bulb were then attached to an Enfield Bullet 350 cc motorcycle battery unit of six volts. The Battery unit was slung over the shoulder keeping a rubber sheet on the chest to prevent damage to the skin. The torchlight could only be used in moonless nights.

Aitanna informed us that the battery units needed charging and would be done at Badvel by 2100 hours. The moon would set by 2400 hours and we would have to be in the foothill-scrub by then. Leaving Aitanna to arrange these details, we left the village with the dead bird for Cuddapah where the skin was prepared for preservation by Mr P. B. Shekar.

FIRST FIELD SIGHTING

I reached Reddipalli at 2200 hours along with the Siddavatam Range Forest Officer. Collecting Aitanna, we went to Badvel to bring his colleagues who had gone there to get the two battery units charged and purchase bulbs for the torches. We reached Reddipalli at 2130 hours and prepared for the night survey.

By 2400 hours, we were nearly a kilometre inside the foothill-scrub and reached the Reserve forests' range demarcation line. The line is about two metres wide and runs along the entire length of the demarcated Lankamalai reserve forest. The non-reserve areas are regarded as 'below' the 'range-line' and reserve areas as 'above' the line. Aitanna wanted us to search both 'above' and below' the line alternatively. We divided into two parties with a battery-unit each and went north-south.

Aitanna's method was to keep walking till he reached the fringe of an open patch in the scrub. Standing beside a bush, he would switch on the torch and scan the open patch. Occasionally he would shine the torch into the smaller bushes. This time he had designed a net fitted into a hoop at the end of a long pole much like a butterfly collection net. This was carried by his colleague. I followed behind them carrying two 4-cell torches.

We kept walking for about an hour along the line till we neared the spot where Aitanna had previously collected the Kalivi-kodi on 12th January. It was an open patch (*c.* area = 70 sq m) circled by thorn scrub bushes (*c.* 200 cm tall). Moving behind the bushline, Aitanna focussed the torch-beam on the patch. Soon enough (0130 hours) it focussed on two birds standing motionless. Turning to his colleague and taking the net from him, he motioned for me to follow.

The birds stood motionless in the open patch. The torch beam never left them. The dark throat patch and the double bands characterising the Double-banded Courser could be easily seen. The net was stiffly held by Aitanna next to his body. Our approach being slow enough for the birds to react, they took off just as we were 4-5 metres from them. As the birds flew up, Aitanna's torch-beam followed them along with beams from my torch and the one given to the former's colleague. The birds broke their ascent flight and glided into the scrub about 10 metres towards the hills. The entire incident must have taken place within one minute.

We left the open patch and walked — with switched-off torches — towards the spot where the birds were presumed to have alighted. Each open patch was being searched quickly by a fast scan with the torch-beam. At approx. 0215 hours, we sighted the two coursers again. They were in a smaller open patch, with a lot of gravel and rubble (consisting of broken fuelwood) lying around. I stayed behind with the third man while Aitanna rushed ahead, but failed. The birds took off the moment Aitanna broke the brushline and stepped into the open patch.

The birds took off in a vertical take-off without any fluttering wing-sound to disclose their flight. As our beams followed them, they repeated the sudden break-off from flight and noiselessly glided into the next open patch. We could see where they had landed. The torch beam from the third man had them under focus while ours' were broken by intervening bushes. Deciding that Aitanna's methods were not productive at that moment, I asked him to avoid another attempt.

We switched off our torches and walked upto the brush-line of the patch keeping the bushes between us and the birds. Aitanna and his colleague sat behind a bush and focussed on the birds. I sat behind a nearer bush and observed the birds in order to confirm that they were indeed the Double-banded Courser. I could only confirm the large eye, the dark throat patch contrasting with the two white bands, and the distinct white supercilium. The characteristic courser posture decided it, before the birds took off once again. I must have seen them for about 7-10 seconds only.

We kept walking about trying to spot more coursers. By about 0700 hours, we had seen two wolves *Canis lupus,* one jungle cat *Felis* sp., three hares, three partridges, two birds that Aitanna claimed were Stone Curlews *Burhinus oedicnemus,* one Quail *Perdicula* sp? and one caniid that we could not identify. The other party — we met at 0630 hours — had not seen any Double-banded Courser.

HABITAT OF THE DOUBLE BANDED COURSER

Jerdon (1877) mentioned "rocky and undulating ground with thin forest jungle" as the habitat of the Double-banded Courser. The Lankamalais were exactly the same. The foothills had been 'worked' approx. 40-50 years ago and were yet to recover. The natural regeneration was severely affected by grazing/browsing and fuelwood collections.

The bush-height below the line was on an average just below 100-150 cm and above the line was 200-350/400 cm. Two to four kilometres above the line, the bushes gave way to thin forests with lesser open patches.

The foothill-scrub forest types were both Thorny and Non-Thorny Scrub Jungle patches (Champion and Seth 1968). While the Thorny Scrub consisted of *Acacia, Zizyphus* and *Carissa* among other species, the Non-Thorny Scrub was made up of *Cassia, Hardwickia, Dalbergia, Butea* and *Anogeissus* among other species. Further ahead, towards the Lankamalai, in varying densities, were a gradual succession and/or an admixture of Thorn and Non-Thorn Scrub to *Hardwickia binata* forests.
The scrub patches were generally 200-400 cm in height while the *Hardwickia* was more than 500 cm tall. The vegetation was also closer and open patches were very few. The *Hardwickia* continued till the foothills and was also present on the lower gentle slopes. The tree species along with *Hardwickia binata* were *Anogeissus, Albizzia* and *Zizyphus* among others.

The *Hardwickia* type is followed by thorn forests dominated by *Anogeissus* along with *Albizzia, Acacia, Zizyphus, Cassia* and *Carissa* among others. The Dry Red Sanders bearing forests were present in the upper slopes and plateaux of the Lankamalais. These forests were dominated by *Pterocarpus santalinus* along with *Anogeissus, Hardwickia* and *Terminalia* among other species (Reddy 1983).

Similar habitat continues from Reddipalli to Siddavatam and Cuddapah-adjuncts. North from Reddipalli, the continuity is towards Badvel and further ahead towards Ahobilam and other areas till the Nallamalais. Eastwards of the Lankamalais, both eastern and western sides of the Velikondas show similar vegetation and topographical features from Udayagiri to Somasila and on to Venkatagiri and Erpedu areas.

South of Siddavatam, the Palakondas show typical Double-banded Courser habitat in Nandalur, Vontimitta, Rajampet, Rayachoti and intervening areas. The other possible locations are the Jammalamadugu-Mylavaram; Marrutla and Rapur-Rajampet areas (Bhushan 1985a & b). Future surveys should be able to locate the Double-banded Courser in these areas.

Measurements:

(Compared to Baker 1929 in Fauna British India)

	Wing	Bill from feathers/skull	Tarsus	Tail
Siddavatam Jan. 1986 ♀ ?	171-172	18.7/24.7	66.52	67.4
Baker 1929 ♂ ♀	161-168	18–19/—	68	64–65

All measurements are in millimetres.

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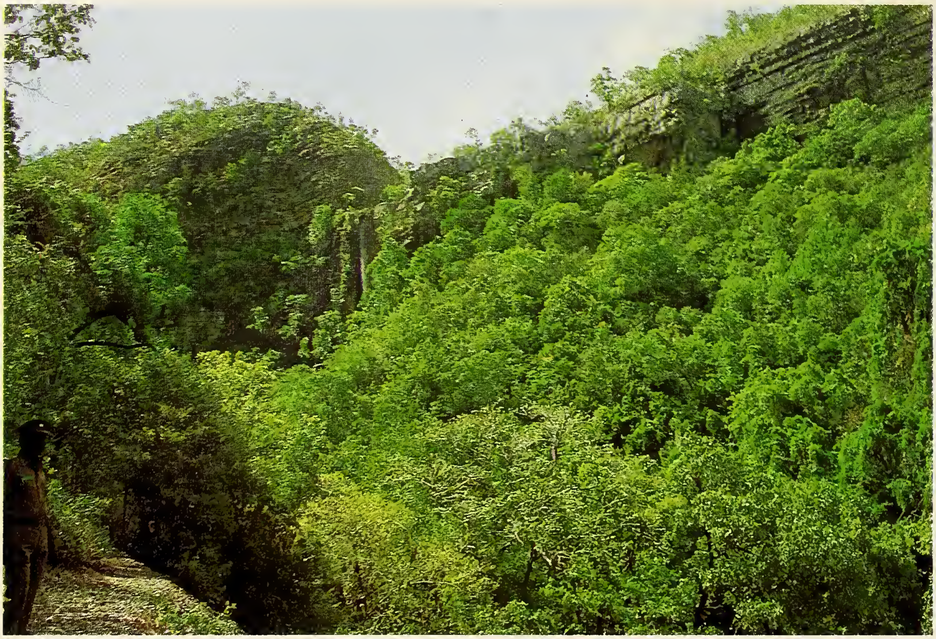
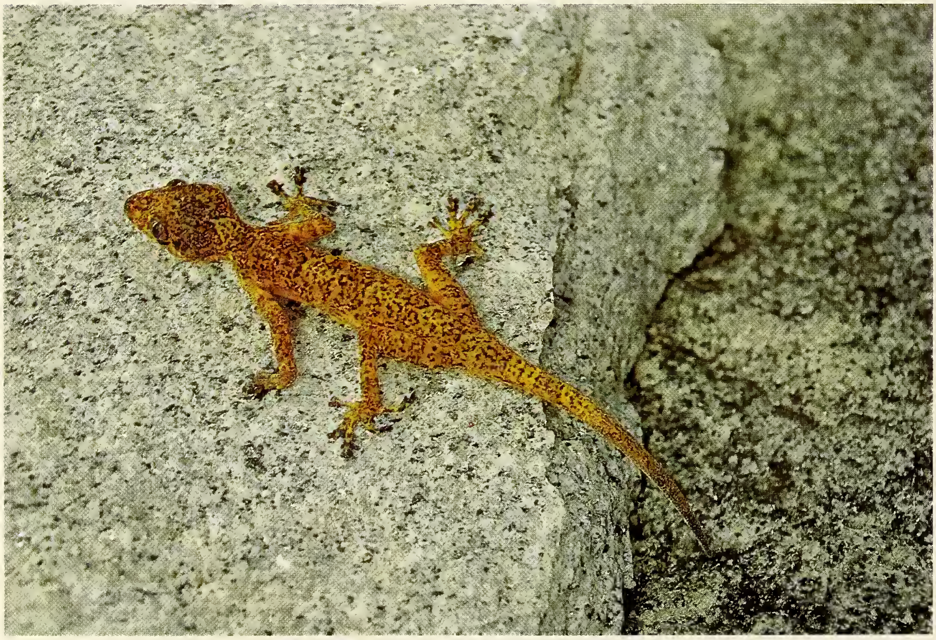


The Habitat of the Golden Gecko.



The Golden Gecko *Calodactylodes aureus* (Beddome). (*Photos:* J. C. Daniel)

REDISCOVERY OF THE GOLDEN GECKO *CALODACTYLODES AUREUS* (BEDDOME) IN THE EASTERN GHATS OF ANDHRA PRADESH[1]

J. C. Daniel, Bharat Bhushan and A. G. Sekar[2]

(*With a colour plate*)

The Golden Gecko *Calodactylodes aureus* was described in 1870 by H. R. Beddome who collected ten specimens (Smith 1935) from the Tirupati hills (named as "Tripatty hills" — Beddome 1870) in the Eastern Ghats complex in the then North Arcot district of Madras Presidency. All known specimens are in the British Museum.

The Tirupati hills (13°41′N and 79°21′E; in the Chittoor district) are part of the Eastern Ghats Complex in southern Andhra Pradesh. The hills are better known as the 'Seshachalam' ranges and together with the Velikondas, Palakondas, Yerramalais, Lankamalais and Nallamalai ranges form the Eastern Ghats complex in southern Andhra Pradesh.

The Velikondas (running north-easterly from Tirupati) are the eastern most among the ranges. Its southern tip lies adjacent to the 'Seshachalam's and has continuous forests from Mamandur-Balapalli areas to Erpedu. North of Cheyyeru river (which cuts across the Seshachalams) are the Palakonda ranges that continue till the confluence of the Pennar and Cheyyeru.

The varied terrain of steep slopes, deep valleys, plains and wide plateaux hold different forest types that can be said to characterise each topographical feature. The plains have typical Thorn Scrub types, though mostly overrun by *Prosopis*. The foothills, wherever forested, shows patches of Non-Thorny Scrub Jungle followed by Tropical Dry Deciduous Forest Types.

The upper slopes and the plateaux have a forest type of pure stands of Red Sanders (*Pterocarpus santalinus*). Most of the plateaux show Miscellaneous Forest Types consisting of *Eugenia, Pterocarpus, Shorea* and also *Eucalyptus* wherever planted. The valleys are the most spectacular, with very luxurient vegetation dominated by tall *Shorea*, Mango and Tamarind trees, which may be due to numerous nearly perennial streams.

These waterfall-fed deep valleys show continuous perpendicular and vertical fissures. The streams that lead away from the fall areas have numerous boulders strewn along their path. It was in these areas that the Golden Gecko was found and collected in July 1985, 115 years after their original description. Specimens were obtained and seen in Seshachalam and Velikonda ranges and may occur in suitable habitats in the other ranges also.

Morphometry

Calodactylodes aureus is characterised by the two horizontal expansions on the vertical eye-slit; and, digits with large trapezoid distal and penultimate expansions among other

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[1] Accepted February 1986.

[2] Bombay Natural History Society, Hornbill House, Shaheed Bhagat Singh Road, Bombay-400 023.

characters (Beddome 1870). The morphometric details of the specimens collected are given in the table below:

Characters	BNHS Collection Registration Nos.			
	1408	1409	1416	1410
sex	♂	♂	♂	♀
Snout to vent	76	81	65	62
Tail	91	80	82	72
Head Length (snout to tympanum)	22	20	21	25
Head width	16	20	15	15
Axilla to Groin	40	36	30	33
Fore Limb	32	32	29	29
Hind Limb	44	44	38	40
Scales on the belly	32	33	32	34
Eye to Snout	10	11	9	9
Eye to Ear opening	5	7	6	6
Diameter of eye	6	7	6	7
Interorbital space	4	5	3	3
Upper Labials	13	12/13	12	12
Lower Labials	13	13	12	12
Digital expansion	2	2	2	2
Size of the gonad	small	medium	large	small

All measurements are in millimetres.

Colour variation

Beddome in his original description mentioned that the Golden Gecko was brilliantly golden in colour. Only two of our specimens were golden. One was brownish black and one was slightly golden yellow with close black granules giving it a black appearance dorsally. One individual was pure golden yellow while one 'Golden Gecko' was distinctly reddish without any sign of golden colour.

The stomach held insect remains, mainly hymenoptera (ants) and beetles in all cases.

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MOVEMENT AND FLOCK COMPOSITION OF THE GREAT INDIAN BUSTARD *ARDEOTIS NIGRICEPS* (VIGORS) AT NANAJ, SOLAPUR DISTRICT, MAHARASHTRA, INDIA[1]

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(*With two text-figures*)

Many animals of the arid zones are nomadic in order to survive the temporal and spatial fluctuations in the food availability in their environment. Food supply, especially for insectivores and herbivores, is generally dependent on precipitation. Numerous workers (e.g. Keast & Marshall 1954, Davies 1968, 1984, Thomas 1984) have shown the correlation between rainfall and movement of birds of the arid areas. The Great Indian Bustard *Ardeotis nigriceps* (Vigors) is a bird of open spaces of scanty grassland interspersed with scrub and cultivation in more or less semi-desert country. It is resident and seasonally nomadic, dispersing widely in the monsoon with the creation of grasslands (Ali & Ripley 1969). The pattern of its local movements have not been studied in detail (Ali 1970).

The Great Indian Bustard (GIB) has become rare [Ripley 1952 (see Editors' comments), Ali 1970, Gupta 1970] but its over-all distributional range has not changed much (Goriup 1980). Due to its rarity and destruction of its habitat, the movements of the GIB have presumably become more erratic. However, with the revival of a few grasslands since 1976 under the Drought-Prone-Areas-Programme (DPAP) in Maharashtra, sightings of the GIB in some rehabilitated areas have become more common especially during the monsoon. The present paper on the local movement and flock composition forms a part of the study of the ecology and behaviour of the Great Indian Bustard. This study is based on unmarked birds, therefore movements outside the study area could not be followed. Daily movements and flock composition of a resident GIB population at Karera (Shivpuri district, Madhya Pradesh) will be dealt with separately.

STUDY AREA AND METHODOLOGY

Study area: Nanaj in Solapur district (17° 41′N, 75°56′E, alt. 486 m) in Maharashtra State, India was selected as one of the field stations. The study period extended from August 1981 to December 1984.

Near Nanaj village three small areas which were previously grazing land were taken over by the State Forest Department in 1976 under the DPAP to be developed as pastures and woodlots. Later more plots were added. The terrain of Nanaj is gently undulating, characteristic of the Deccan Plateau. The climate is dry and the maximum temperature varies from 25.5°C in winter to 42.5°C in summer.

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The year can be divided into three seasons: winter (Nov.-Jan.); summer (Feb.-June) and monsoon (July-Oct.). Solapur district is semi-arid (meaning an area with 7-8 months of the year dry and an annual rainfall of less than 750 mm (Bagnols & Gaussen 1957). Average annual precipitation in Solapur is 724 mm. Rainfall is erratic and ill distributed with year to year fluctuations.

Methodology: In order to determine the local movement and flock composition of the GIB, a daily record of the following parameters was kept, namely (1) Total number of bustards seen in the study area, (2) Maximum number of birds seen in a flock, (3) Flock composition, (4) Plot(s) where seen, (5) Time, (6) Local weather conditions and, (7) Local movements between plots to record habitat preference. Mother and chick were taken as one unit as they were always seen together. Only post-juvenile chick was noted separately. Birds moving together for hours were considered as a group or a flock. Temporary association while foraging was not noted as a flock. Every week the maximum number of bustards seen on any day, and the maximum number seen in a flock was noted (figs. 1 & 2). Even bustard(s) seen for a day or two in any particular week was included in the histograms. In 1983, for instance, between 25 to 31 December two hens were seen on 26th evening after a slight drizzle, they were not seen the next morning but in Figure 1 C, covering that particular week they are shown as if present throughout the week.

RESULTS

Annual Movement of Bustards

1981: During a preliminary visit to Nanaj on 29th April, the area was totally dry and no bird was sighted (fig. 1, A). In the second visit in August, eight bustards (three males and five females) were sighted. The monsoon had already started (fig. 2, A) and the birds were settling to breed. Thereafter, one or two males and four to five females were regularly seen. By the third week of November, the territorial cock was irregularly seen and soon all the females left the area with their respective chicks, except for one late-nester which was seen till mid-December.

1982: No bird was seen from January till April. There were unseasonal showers from mid-April as a result of which grass started growing. Though there was no rain during the next week, the sky was generally overcast. Between 30 April and 6 May, 3.5 mm of rain fell. First two, then three male bustards were seen together and no agonistic behaviour was noted probably because the breeding season had not started.

Due to erratic rains at Nanaj in 1982, and consequently greening and drying of grass alternately, daily bustard movement was also unpredictable. Though the territorial cock was seen more or less throughout the breeding season, non-territorial males and females were not seen daily, or were seen in highly fluctuating numbers (fig. 2, B). Breeding was not recorded (Table 4) and most of the females were seen in twos or threes or occasionally in group-size of six to seven birds (Table 2, B). In October, the females were not seen at all in our study area (Table 2, B) and we presume they had moved in search of more favourable areas for nesting. (In 1983 we saw two juvenile chicks with their respective mothers, which shows that the birds had nested elsewhere).

1983: A few mm of rain fell between 6

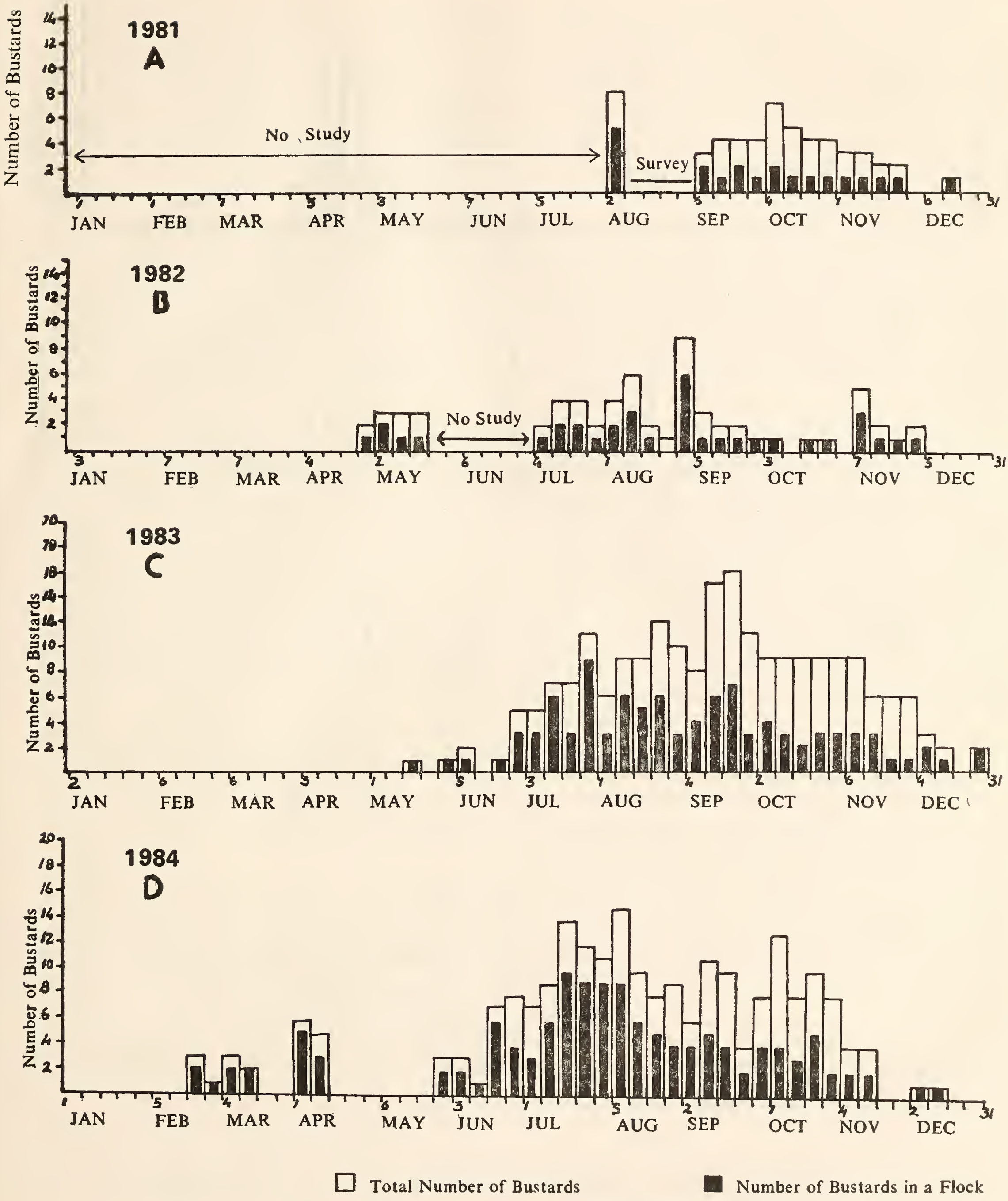

Fig. 1. Movement of bustards at Nanaj.

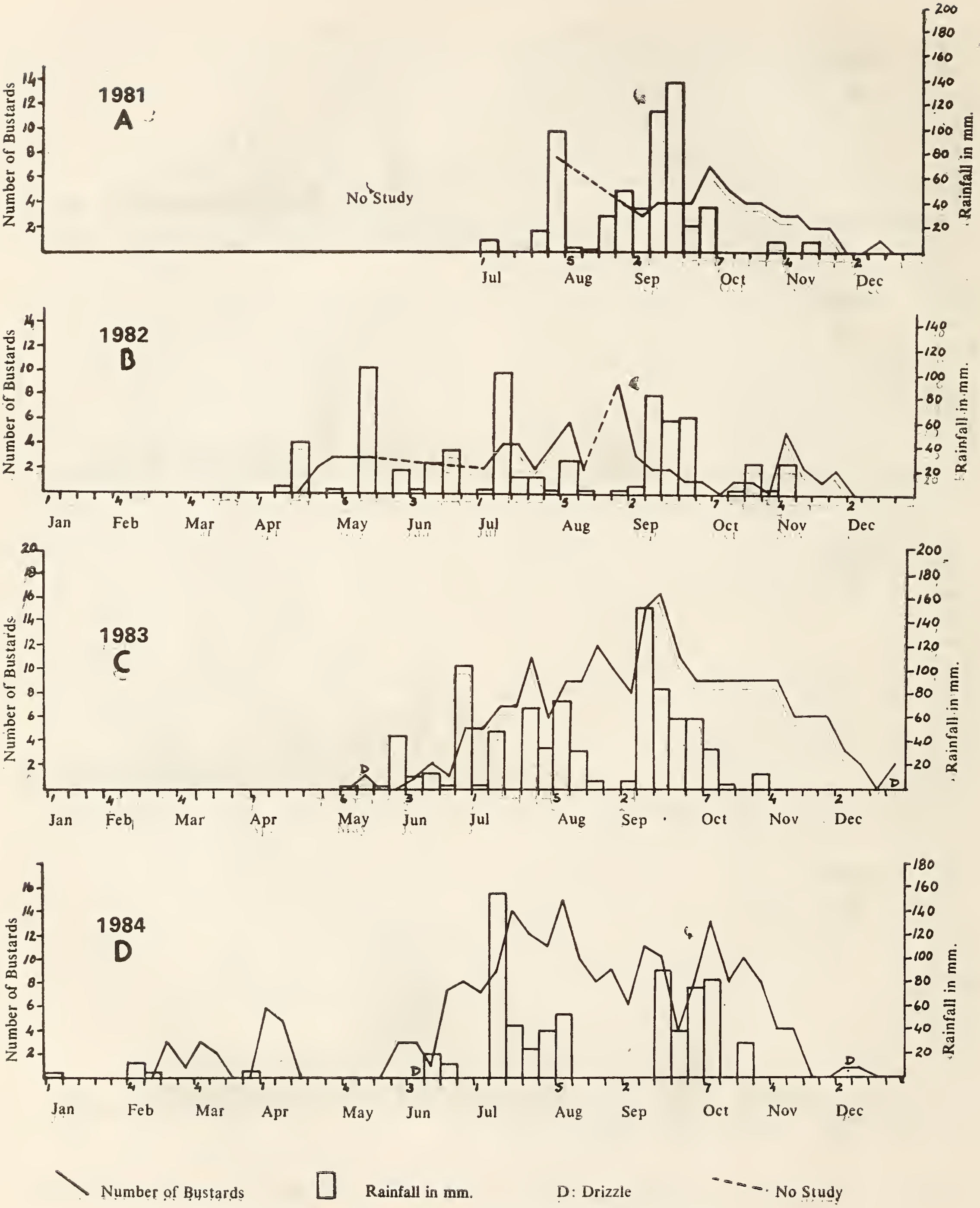

Fig. 2. Rainfall and movement of bustards at Nanaj.

and 12 May (fig. 2, C) and the first bustard, an adult cock, was sighted on 14 May when there was a slight drizzle. In June, one or two males were occassionally seen, either solitarily or together. A female was seen for two days in June. By the last week of June, the monsoon started in full force, resulting in the reappearance of bustards. Due to sufficient and timely rains between July and November (fig. 2, C), seven to ten birds were seen almost daily. Many hens bred (Table 4) and were seen solitarily while the non-breeders moved in small groups (Table 2, C). The territorial cock was seen till the second week of December.

The maximum number of birds in 1983 was seen in the morning of 18 September while it was raining: twelve birds, mainly females, in small groups of 3-4 birds, one hen on the nest, and the territorial cock in the display area. The same evening, six males were seen foraging together. During another rainy day (24th September), eight males (seven in one flock) were observed in one plot, and six females in another plot.

1984: Three female bustards were seen outside our main study area in the third week of February after a few days of rain and cloudy weather. One was probably with a post-juvenile female chick.

Due to unseasonal showers in February and April, the GIB returned to Nanaj (fig. 2, D) but soon disappeared when it again became hot and dry. Till the monsoon started on 11 July, there was a constant movement of bustards depending upon the local weather conditions.

Heavy rains on 11 July brought six females and a young male. During another rainy day, nine females in one flock, three sub-adult males and the territorial cock were seen. Unseasonal dry weather between 13 August and 16 September, greatly reduced the adult grasshopper population therefore many birds left the area. By October, except for the territorial cock and two females with a chick each, other birds were erratically seen. As expected, more birds were seen during rainy or cloudy days. For example, on 22 October, five birds (two adult cocks and three hens) were seen, but after the rains on 22nd night, ten birds were counted the next morning.

Flock composition: During the breeding season, the adult cock bustard remains solitary (Tables 1, 2, 3). Most of the sightings of two or three adult cocks in a flock were in the non-breeding months (e.g. April-May in 1982, June in 1984). During the breeding season, only the subadult males stay together. The most common male flock size was two. However, during a rainy day the males of an area sometimes congregate like females (see below). For example, seven males were seen together in September 1983 during a rainy day.

The adult cock tolerates a juvenile male, especially away from the display ground. This toleration was more markedly seen in 1982 and 1984, two bad years as far as breeding is concerned. For example, in August 1983 (Table 2, C) the territorial cock was always seen alone or near females but in August 1984 (Table 2, D) it occasionally tolerated a juvenile male.

In the non-breeding season, most of the hens live in flocks consisting of 2-10 birds (Table 2). A single female is rarely seen between January to June. With the onset of monsoon in July/August, the bustards come to Nanaj. The females arrive in group size

TABLE 1

NUMBER OF GROUPS (n) AND PERCENTAGES (%) OF BUSTARDS IN DIFFERENT MONTHS AT NANAJ

1981-A

* No study.

Group Size	Jan*	Feb*	Mar.*	April*		May*		June*	July*		Aug.		Sept.		Oct.		Nov.		Dec.	
											n	%	n	%	n	%	n	%	n	%
1											3	50	6	85.7	68	95.7	17	100	1	100
2											1	16.6	1	14.2	3	4.1	0	—	0	—
3											0	—	0	—	0	—	0	—	0	—
4											1	16.6	0	—	0	—	0	—	0	—
5											1	16.6	0	—	0	—	0	—	0	—
Total sightings											6		7		71		17		1	
Mean group size											2.3		1.1		1		1		1	

1982-B

Group Size	Jan*	Feb*	Mar.*	April*		May*		June*	July*		Aug.		Sept.		Oct.		Nov.		Dec.	
				n	%	n	%		n	%	n	%	n	%	n	%	n	%	n	%
1				0	—	5	45.4	**	21	75	18	66.6	8	44.4	5	100	15	75	2	100
2				1	100	3	27.2		4	14.2	7	25.9	6	33.3	0	—	3	15	0	—
3				0	—	3	27.2		3	10.7	2	7.4	1	5.5	0	—	0	—	0	—
4				0	—	0	—		0	—	0	—	0	—	0	—	2	10	0	—
5				0	—	0	—		0	—	0	—	0	—	0	—	0	—	0	—
6				0	—	0	—		0	—	0	—	2	11.1	0	—	0	—	0	—
7				0	—	0	—		0	—	0	—	1	5.5	0	—	0	—	0	—
Total sightings				1		11			28		27		18		5		20		2	
Mean group size				2		1.8			1.3		1.4		2.3		1		1.4		1	

TABLE 1 (contd.)

1983-C

Group Size	Jan	Feb. n	Feb. %	March n	March %	April n	April %	May n	May %	June n	June %	July n	July %	Aug. n	Aug. %	Sept. n	Sept. %	Oct. n	Oct. %	Nov. n	Nov. %	Dec. n	Dec. %
1								1	100	10	100	34	56.6	87	76.3	66	64	93	77.5	88	82.2	8	57.1
2								0	—	0	—	3	5	15	13.1	17	16.7	15	12.5	10	9.3	6	42.8
3								0	—	0	—	11	18.3	6	5.2	10	9.7	9	7.5	5	4.6	0	—
4								0	—	0	—	4	6.6	4	3.5	4	3.8	3	2.5	4	3.7	0	—
5								0	—	0	—	5	8.3	1	0.8	1	0.9	0	—	0	—	0	—
6								0	—	0	—	2	3.3	0	—	3	2.9	0	—	0	—	0	—
7								0	—	0	—	0	—	1	0.8	2	1.9	0	—	0	—	0	—
8								0	—	0	—	0	—	0	—	0	—	0	—	0	—	0	—
9								0	—	0	—	1	1.6	0	—	0	—	0	—	0	—	0	—
Total sightings								1		10		60		114		103		120		107		14	
Mean Group size								1		1		2.2		1.4		1.7		1.3		1.2		1.4	

1984-D

Group Size	Jan	Feb. n	Feb. %	March n	March %	April n	April %	May n	May %	June n	June %	July n	July %	Aug. n	Aug. %	Sept. n	Sept. %	Oct. n	Oct. %	Nov. n	Nov. %	Dec. n	Dec. %
1		3	60	7	50	3	21.4	0	—	22	62.8	33	51.5	68	57.1	70	56.9	70	61.9	34	79	2	66.6
2		2	40	7	50	7	50	0	—	3	8.5	4	6.2	25	21	38	30.8	23	20.3	5	11.6	1	33.3
3		0	—	0	—	3	21.4	0	—	4	11.4	10	15.6	7	5.8	7	5.6	9	7.9	3	6.9	0	—
4		0	—	0	—	0	—	0	—	3	8.5	2	3.1	5	4.2	7	5.6	9	7.9	1	2.3	0	—
5		0	—	0	—	1	7.1	0	—	0	—	2	3.1	7	5.8	1	0.8	2	1.7	0	—	0	—
6		0	—	0	—	0	—	0	—	3	8.5	3	4.6	4	3.3	0	—	0	—	0	—	0	—
7		0	—	0	—	0	—	0	—	0	—	1	1.5	1	0.8	0	—	0	—	0	—	0	—
8		0	—	0	—	0	—	0	—	0	—	2	3.1	0	—	0	—	0	—	0	—	0	—
9		0	—	0	—	0	—	0	—	0	—	5	7.8	1	0.8	0	—	0	—	0	—	0	—
10		0	—	0	—	0	—	0	—	0	—	2	3.1	1	0.8	0	—	0	—	0	—	0	—
Total sightings		5		14		14		0		35		64		119		123		113		43		3	
Mean group size		1.4		1.5		2.2		—		2.0		3.0		2.8		1.6		1.6		1.3		1.3	

TABLE 2

NUMBER OF SIGHTINGS OF MALE (♂); FEMALE (♀) AND MIXED (M) FLOCKS OF BUSTARDS AT NANAJ.

— Birds not in the area. * No study

1981-A

Group Size	Jan.	Feb.	March	April			May			June	July			Aug.			Sept.			Oct.			Nov.			Dec.		
														♂	♀	M	♂	♀	M	♂	♀	M	♂	♀	M	♂	♀	M
1	**	**	**	**			**			**	**			3	0	0	4	2	0	18	50	0	6	11	0	0	1	0
2														0	1	0	0	1	0	0	3	0	0	0	0	0	0	0
3														0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
4														0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
5														0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Mean group size														1	3.6		1	1.3		1.1	1		1	1			1	

1982-B

				♂	♀	M	♂	♀	M		♂	♀	M															
1	—	—	—	0	0	0	3	2	0	**	21	0	0	18	0	0	8	0	0	5	0	0	14	1	0	1	1	0
2				1	1	0	1	1	1		2	1	1	2	4	1	6	0	0	0	0	0	0	3	0	0	0	0
3				0	0	0	2	0	1		0	0	3	0	2	0	1	0	0	0	0	0	0	0	0	0	0	0
4				0	0	0	0	0	0		0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0
5				0	0	0	0	0	0		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6				0	0	0	0	0	0		0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0
7				0	0	0	0	0	0		0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
Mean group size				2	2		1.8	1.3	2.5		1	2	2.7	1.1	2.3	2	1.5	6.3		1			1	2.5		1	1	

TABLE 2 (contd.)

1983-C

Group Size	Jan.	Feb.			March			April			May			June			July			Aug.			Sept.			Oct.			Nov.			Dec.		
											♂	♀	M	♀	♂	M	♂	♀	M	♂	♀	M	♂	♀	M	♂	♀	M	♂	♀	M	♂	♀	M
1	—	—			—			—			1	0	0	8	2	0	33	1	0	41	46	0	28	38	0	44	49	0	34	54	0	1	7	0
2											0	0	0	0	0	0	0	3	0	0	15	0	4	13	0	1	14	0	0	10	0	0	6	0
3											0	0	0	0	0	0	0	11	0	0	6	0	2	8	0	0	9	0	0	5	0	0	0	0
4											0	0	0	0	0	0	0	4	0	0	4	0	0	4	0	0	3	0	0	4	0	0	0	0
5											0	0	0	0	0	0	0	5	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0
6											0	0	0	0	0	0	0	2	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0
7											0	0	0	0	0	0	0	0	0	0	0	1	1	1	0	0	0	0	0	0	0	0	0	0
8											0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9											0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mean group size											1			1	1		1	3.7		1	1.6	7	1.4	2		1	1.5		1	1.4		1	1.4	

1984-D

		♂	♀	M	♂	♀	M	♂	♀	M																								
1	—	1	2	0	1	6	0	3	0	0	—			21	1	0	33	0	0	52	16	0	54	16	0	59	11	0	25	9	0	2	0	0
2		0	2	0	0	7	0	0	7	0				0	3	0	1	3	0	14	11	0	13	25	0	11	12	0	0	5	0	0	0	1
3		0	0	0	0	0	0	0	3	0				1	3	0	2	8	0	2	5	0	3	4	0	1	8	0	0	2	1	0	0	0
4		0	0	0	0	0	0	0	0	0				0	3	0	0	2	0	1	4	0	0	7	0	0	8	1	0	1	0	0	0	0
5		0	0	0	0	0	0	0	1	0				0	0	0	0	2	0	1	6	0	0	1	0	0	1	1	0	0	0	0	0	0
6		0	0	0	0	0	0	0	0	0				0	0	0	0	3	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0
7		0	0	0	0	0	0	0	0	0				0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
8		0	0	0	0	0	0	0	0	0				0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9		0	0	0	0	0	0	0	0	0				0	0	0	0	5	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
10		0	0	0	0	0	0	0	0	0				0	0	0	0	2	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Mean group size		1	1.5		1	1.5		1	2.5					1	3.5		1.1	5.5		1.3	3		1.2	2		1.1	2.4	4.5	1	1.7	3	1		2

Table 3

Number of sightings, percentages and means of the GIB at Nanaj from 1981 to 1984

Group	Year				Percentage			
Size	1981	1982	1983	1984	1981	1982	1983	1984
1	95	74	387	312	93.1	66	73.1	58.5
2	5	24	66	115	4.9	21.4	12.4	21.5
3	0	9	41	43	—	8	7.7	8
4	1	2	19	27	0.9	1.7	3.5	5
5	1	0	7	13	0.9	—	1.3	2.4
6	0	2	5	10	—	1.7	0.9	1.8
7	0	1	3	2	—	0.8	0.5	0.3
8	0	0	0	2	—	—	—	0.3
9	0	0	1	6	—	—	1.1	1.1
10	0	0	0	3	—	—	—	0.5
Mean	1.11	1.57	1.53	1.90				

Mean Group size of four years = 1.6 birds.

Table 4

Number of sightings (n) of female groups during the breeding season (July-December) at Nanaj

Year	Solitary Female		In groups (2-10)		Breeding success (No. of eggs)	Total sightings of Females
	n	%	n	%		
1981*	64	90.1	7	9.8	5	71
1982	2	9.1	20	90.9	Nil	22
1983	192	59.1	133	40.9	15	325
1984	52	27.2	139	72.7	3	191

(* August to December).

ranging from 2 to 10 birds (Table 2, C, D). Generally in any particular day all the females of an area are seen in one flock. As the breeding season progresses, one by one the females separate for nesting, thus sighting of solitary females between August and November becomes more common (Table 4). Only the juvenile females and non- or late-nesters remain together. As the chicks are fledged, the hens leave the area with their respective chick, thus departure of female bustards from Nanaj is gradual. More solitary females (or with a chick) are seen during November/December (Table 2). Occasionally two hens each with about-to-be-fledged chick move together but this association is not permanent.

Female and male of the GIB are rarely seen together (Table 2, A-D). Most of the sightings of mixed flocks were of a post-juvenile male with its mother and other hens (e.g. August 1983, Table 2, C). Nevertheless, once or twice we did see adult male(s) with adult female(s) (e.g. in May and July 1982) but this association was not permanent as in an all-female flock.

DISCUSSION

Influence of rain on the movements of bustards: Jerdon (1864) was the first observer to point out that the Great Indian Bustard occurs in large numbers in the rainy season in the Deccan plains. Davidson & Wenden (1878) also mentioned that "they are very much more common (in Deccan) during the rains and cold season than at other times". Hume and Marshall (1880) noted that in the Sirsa district it is "extremely abundant during the rainy season, when it breeds, whereas during the cold season, it is comparatively scarce". Fraser (1881) mentions seeing 80-100 bustards near Malegaon (Maharashtra) in 1840's. He adds "whether a flight of locusts or grasshoppers had alighted to attract this extraordinary flight of birds, or whether they assembled for migratory purposes, I cannot say.....". Baker (1929) on the basis of existing literature and "numerous letters from observers and sportsmen" wrote that the GIB in many parts of India is most irregular in its movement, and that in other parts it is merely a seasonal visitor, either for the purpose of breeding or during the non-breeding season. Ali & Ripley (1969) have summarized its habit as resident and seasonally nomadic, dispersing widely in the monsoon with the creation of grasslands.

Our studies also reveal that the maximum number of bustards and the largest flocks at Nanaj were sighted during rainy days (weeks in the histograms, Figs. 1, 2), Even unseasonal showers in February and March 1984 bringing back a few birds. Dharmakumarsinhji (1957) also noted that sudden and erratic rainfall during the winter in certain localities will attract a bird or two, who go there in the hope of finding better food. The Australian Bustard *Ardeotis australis* (Mathews 1913, White 1983) also has the habit of flocking to certain grasslands after the rains.

Tyabji (1952) reported seeing congregations of 200 or 300 bustards in 1923 between Ahmednagar and Manmad, and later (in 1926) of about 400 birds again near Manmad. Commenting on these unusual sightings, Dharmakumarsinhji (1953) opined that Tyabji might have confused the Eastern Common Crane *Grus grus lilfordi* with the bustard. The Editors (1953) of the JBNHS support Dharmakumarsinhji's opinion. Burton (1954) was also sceptical and wrote "In these days of the bustard in India having become a vanishing species it should be reported that during the years 1923-26, flocks of 200-400 bustards were seen". We think that in the olden days it would not have been unusual for the GIB to congregate at some prime grasslands in large numbers during certain seasons. The closely related Australian bustard is reported to have been seen in a loose group of 300 birds (Mathews 1913) and in 1897 even in a flock of one thousand (Barrett 1945).

Tyabji has not given the dates of sightings and the weather conditions to set the record straight. The Eastern Common Crane is a winter visitor, most abundant in the north-western parts of the subcontinent, straggling south to, the former Deccan down to *c.* 18°N lat. (Ali & Ripley 1969). Most of the bustard congregations were recorded by us during the monsoon, the time when the Crane is not present in the country. Therefore, there is no chance of confusing the two species *if* Tyabji had seen the bustards during the monsoon.

The GIB still survives in Ahmednagar district and the topography is most suited for this species. Incidentally, the largest number of bustards (961) were shot in Ahmednagar district between 1808 and 1833 (Elliot 1880), so in the olden days, Ahmednagar along with Solapur seems to have been one of the strongholds of this species. Due to the erratic nature of the rainfall in these districts, it is not unlikely that 200-400 bustards had congregated in some locally good rainfall section of the region.

On 18 July 1984, while it was raining, we counted 35 bustards in a grassland of about 200 ha near Rollapadu village, Kurnool district of Andhra Pradesh. A thorough search in the surrounding agricultural fields could not reveal any more bustard, so obviously, most of the birds of that region had concentrated in that small grassland to feed on the abundant grasshoppers. Earlier to this sighting the GIB had been considered almost extinct in Andhra Pradesh and Pushp Kumar (1980) had reported that probably only 15 GIB were left in the State though "no census has been carried out". When 35 bustards could be seen in 1984 in a small area when the GIB has become much more uncommon, the sighting of 200-400 bustards, about sixty years ago in their main stronghold should not be considered so impossible. Moreover, Tyabji's comments that he had seen the bustards "not in a flock, but scattered 50 to 100 paces from each other", and that when one was shot, the birds flew "not in a flock but scattered all over the countryside" strongly supports his assertion that the birds were GIB, and not cranes. The Common and Demoiselle (*Anthropoides virgo*) cranes keep in large cohesive flocks and when disturbed generally fly off together noisily. On the contrary, the GIB are generally found in loose parties and when disturbed, scatter in different directions.

Precipitation determines the greening of vegetation and indirectly in the increase of insect populations on which the bustards normally feed. Recently Davies (1984) has shown that nomadism is an adaptation in response to desert conditions where finding adequate food in a particular place year by year is less predictable for some birds than in higher rainfall areas. Emus *Dromaius novaehollandiae* (Davies 1968, 1984) and sandgrouse (Thomas 1984) also move towards recent rainfall areas in search of food and for nesting.

The bustard is known to be a "rains-breeder", especially in the arid and semi-arid regions of its distribution. Dharmakumarsinhji (1954) states that, like the Lesser Florican *Sypheotides indica* the breeding season of the bustard is dependent on the rains. Regarding the breeding season of the bustards of Solapur Davidson & Wenden (1878) state "the birds come in, in the beginning of the rains to breed and leave, when the young are able to fly". Davidson and Wenden's above statement agrees with our findings. The GIB's arrival with the rains and dependence on adequate precipitation for breeding is not difficult to understand, as in semi-arid areas, animals and plants are almost completely dependent on rainfall (Tree 1972). And since the majority of birds breed at a time when food is most plentiful for the young (Thompson 1950, Skutch 1950, Moreau 1950, Lack 1950, 1968 and Perrins 1970) the bustards of Nanaj come and breed during the monsoon.

Flock composition: Many workers (e.g. Gupta 1970, Neginhal 1980, Kapoor and Bhatia 1980, etc.) have reported seeing the GIB in pairs. On the contrary our studies reveal that pair formation as seen in geese, sarus, mynas, bulbuls etc., is not found in the GIB and they rarely live in pairs. A hen with her post-juvenile male young one is generally confused as a pair.

The male and the female of the GIB stay in their own flocks. Mixed flocks are rare (Table 2) and temporary. Even in a mixed flock, different sexes form their own sub-groups, except for the post-juvenile male which is strongly attached to its mother.

Though the sex ratio is not known in the GIB, apparently there are more females than males. Most of the larger group sizes (8-10) were of females and in all the four years, more females were sighted than males (Tables 1, 2).

The larger female groups break up into smaller units as the breeding season progresses and the females start nesting separately. As expected, solitary females were more commonly seen at Nanaj in good breeding years (i.e. 1981 and 1983) than in bad breeding years (i.e. 1982 and 1984) (Table 4).

The mean group size of female GIB is more than the mean group size of males (Table 2, A-D). Moreover, the mean group size of females also varies in different months and in different years depending on the breeding chronology. It should be noted that due to strict protection, the GIB population is increasing at Nanaj (and elsewhere in Solapur district), therefore, in addition to sighting of more birds in later years (fig. 2, C-D) the mean group size was also more in 1983 and 1984 compared to 1981-82.

Taking the total number of sightings and the total number of birds seen during these sightings, the mean group size of four years comes to 1.6 birds. This is much below expectation. The mean group size of Blue Korhaan *Eupodotis caerulescens* (Maclean *et al.* 1983) was 3.39 birds, and of Karoo Korhaan *E. vigorsii* (Viljoen 1983) was 2.35 birds. Maclean *et al.* (1983) think that this difference is probably because the Blue Korhaan inhabits a less severe environment and lays a clutch of two eggs (as opposed to one egg in the desert dwelling Karoo Korhaan). The GIB also lays one egg (Dharmakumarsinhji 1957, Ali & Ripley 1969) and the chick moves with the mother for about a year (this study). Even then we found the mean group size for all the four years of study to be less than two birds (Table 3). This can be explained by the fact that the birds were sighted mainly during the breeding season and the maximum sightings were of the solitary cock and the nesting hens resulting in bias in the data. A more detailed study of marked and/or radio-collared GIB throughout the year would perhaps indicate that the nomadic population of the GIB of the Deccan region live in a mean group size of more than two birds.

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WILDLIFE IN BANGLADESH MANGROVE ECOSYSTEM[1]

MOHAMMAD ALI REZA KHAN[2]

(*With a text-figure*)

The wildlife of the mangrove ecosystems of the Sunderbans, Chakoria Sunderbans and other mangrove formations in Bangladesh comprises of about 400 species, including eight amphibians, 50 reptiles, 261 birds and 49 mammals. Several of these are either endangered or vulnerable particularly species restricted to these ecosystems.

INTRODUCTION

A great variety of wildlife, defined here as all organisms from Amphibia to Mammalia, has enriched the mangrove ecosystems of the Sunderbans, Chakoria Sunderbans and tidal forests of Bangladesh. It is quite evident from the century-old as well as current literature, *viz.*, Baker 1887, O'Malley 1908, Law 1945, 1948a & b, 1954, Mitra 1957, Mukherjee 1959, Mandal 1964, Acharji & Mukherjee 1964, Mukherjee & Gupta 1965, Mountfort 1969, Biswas 1973, Hendrichs 1975, Mukherjee 1975, Green 1978, Seidensticker & Hai 1978, Gittins 1981, Khan 1981, 1982a & b, Khan & Ahsan 1981, and Khan & Rahman 1982.

Most of the mangrove vegetation of Bangladesh lies within the Sunderbans of Khulna district. This covers 62% of the total Sunderbans of Bangladesh and West Bengal of India, the latter comprising 38% (Hendrichs 1975). The total area of Bangladesh Sunderbans is about 5800 km², of which 4100 km² are land and 1700 km² water. Bangladesh Sunderbans have been divided into four forest ranges, 14 blocks and 55 compartments varying in size from 40 to 160 km² (Fig. 1). There are some isolated, small patches of both planted and naturally growing mangrove vegetation along the southern parts of the districts of Patuakhali, Barisal, Naokhali and Chittagong, mostly on the inshore and offshore islands and coast. This type of forest also occurs in the Chakoria Sunderbans, 21°45′N and 92°E; Whykeong, 21°05′N and 92°12′E, and Teknaf 21°N and 92°15′E along the River Naaf, bordering Burma; and on the lone coral island of the country — St. Martin's, 23.35°N and 92.22°E (Fig. 1).

From the wildlife point of view, the forests of the Sunderbans of Bangladesh and India were studied by Hendrichs (1975) and Mukherjee (1975), respectively. The Bangladesh Sunderbans lie between 21°31′N to 22°30′N and 89°E to 90°E. Gittins (1981) working with the Rhesus Macaque of the Sunderbans divided the forest into three zones according to the salinity of the surrounding water, but without providing the range of salinity.

(i) the fresh-water zone — to the North and East of a line drawn from Cobadak

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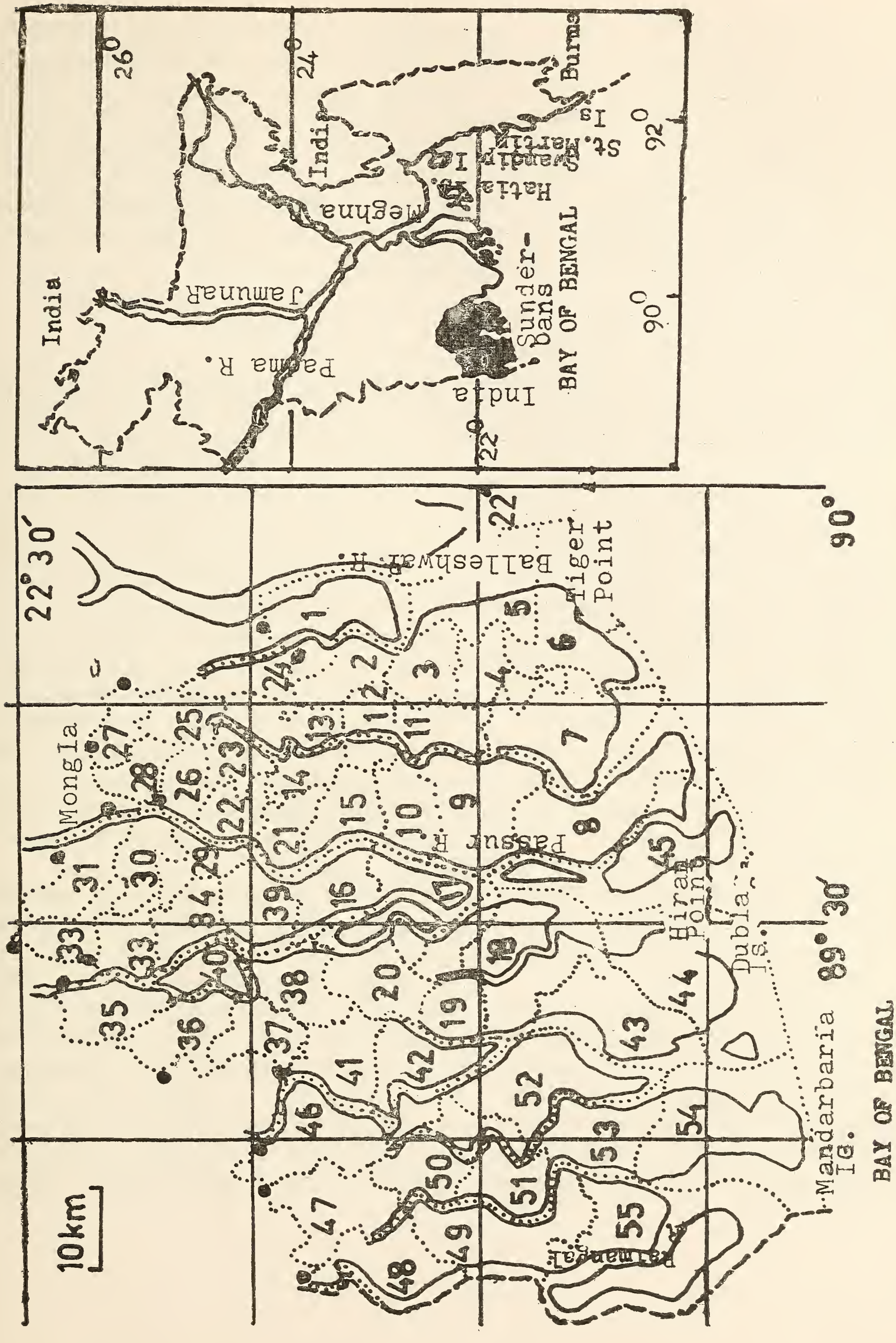
India
Jamuna R
Padma R.
Meghna
India
Burma
Hatia Is
Swandip Is
St. Martin Is
Sunderbans
BAY OF BENGAL
India
26°
24°
22°
90°
92°
22° 30'
Mongla
Balleshwar R.
Tiger Point
Passur R.
Hiran Point
Dubla Is.
Mandarbaria Is.
Raimangal
89° 30'
90°
10km
BAY OF BENGAL

Fig. 1. Bangladesh Sunderbans showing forest compartments. Inset: Bangladesh showing Sunderbans.

Forest station (22°15′N, 89°20′E) in the North to the mouth of Katka Khal (21°50′N, 89°45′E) on the sea face, consisting of 1920 km^2 of *Heritiera fomes* dominated forest:

(ii) moderately salt-water zone — West of the above line to the Malancha River (21°40′N, 89°18′E), consisting of 1324 km^2 of *Excoecaria agallocha* dominated forest: and

(iii) the salt-water zone — West of the Malancha River to the international boundary with India, consisting of 781 km^2 of sparse *E. agallocha* and dense patches of the palm *Phoenix paludosa.*

The plants of the Sunderbans show marked adaptation to life under saline condition and to frequent inundation by the tides. Thus, they have developed succulent leaves, stilt roots, pneumatophores and vivipary. *H. fomes* and *E. agallocha* cover the most part of the Sunderbans. *Oryza coarctata, Nipa fruticans* and *Imperata cylinderica* are prevalent on the mudflats.

The *Chakoria* Sunderbans, 84 km^2, is dominated by *Dalbergia spinosa* and *Aegialitis rotundifolia.* The planted areas and the mangrove formations of the islands, including those along the River Naaf, consist mainly of *Sonneratia* spp., *Avicennia* spp. and *Acanthus ilicifolius,* whereas that of the St. Martin's has stunted *Lumnitzera racemosa, Aegialitis rotundifolia* and *Caesalpinia crista.*

The Sunderbans ecosystem presents a unique opportunity of studying wildlife which no other ecosystems *viz.*, the dry and moist deciduous sal forests, semi-evergreen and evergreen forests of the central and eastern Bangladesh, could provide. As far as wildlife is concerned, the Bangladesh Sunderbans is one of the most open forests of all, in spite of the compactness of the trees. This is mainly because innumerable khals (channels) and rivers cut the whole of the Sunderbans into thousands of fragments. The peripheries of all fragmented pieces of forest make it convenient for the wildlife to utilize these open and well-lighted areas, which are to some extent similar to the ecotonal zones of other forest ecosystems.

METHOD

During 1980 and 1982 I and one of my research fellows paid a total of five visits to the Khulna Sunderbans, where we covered 608 km, including 64 km on foot, 187 km in a dinghy and 357 km in powered boats. About 200 hours spread over 30 days, were devoted to the field observations. A little over 15 days were spent on the St. Martin's Island and 15 days on various other islands, and many visits were made to the mangrove formations along the River Naaf. A research fellow monitored the activities of the Crab-eating Macaque and other wildlife of the River Naaf mangrove formation at Whykeong. I paid one visit to the Bay of Bengal on board the fishing vessel 'Anushandhani' in January 1981 and spent four days in the bay, south of the Khulna Sunderbans.

Most of the wild animals, given in appendix I, were observed by myself and a few by the research fellows. Records of the extinct and some uncommon wildlife have been taken from Mitra (1957), Hendrichs (1975) and Mukherjee (1975). The wildlife were noted either from direct visual observation, from foot-prints, pugmarks, scats on the muddy shores, faecal materials or calls. Nocturnal observations were made with the help of a 4-cell spotlight and headlight of the powered boats. Animals which occurred in the human habitations or forest villages bordering the Sunderbans have also been included in the appendix and in all calculations. The number of such wildlife species probably does not exceed five per cent of the total number of species listed.

The stratification patterns or vertical layering of the wildlife of the various mangrove ecosystems are based on the mode of food gathering and not on the habitat preferences. They have been categorized as aquatic, terrestrial, amphibious, arboreal, arbo-terrestrial and shore-dwellers, depending upon collection of food from water, land, and both, from foliage, foliage and land, and from mud-flats and/or sand-flats. The arboreals included those animals which fed on both plant and animal matter from the trees or shrubs/herbs, and winged insects/animals through aerial pursuits, e.g., flycatchers, bee-eaters, bats, etc.

The wildlife has been classified as carnivores, omnivores and herbivores basing on the natural feeding behaviour. Those found by us or known to be feeding on live or dead animals, from invertebrates to mammals, have been categorized as carnivores. These include both insectivores, piscivores, carrion-feeders and other flesh-eaters. Omnivores include these wildlife which fed almost equally on animal and plant matter. The herbivores either fed on ground vegetation through grazing; on climbers, lianas and shrubs through browzing; or on leaves, fruits, buds and bark of mangrove trees. Wildlife which normally fed on animal matter and casually collected nectar and other such plant matter have been included under carnivores, e.g., drongos, magpie-robins, babblers, etc.

Attempts have been made to provide a population estimate of chital (spotted deer) and rhesus macaque.

RESULTS AND DISCUSSION

The amphibia included eight species belonging to four genera of four families (appendix I). It is dominated by *Rana hexadactyla* — a brackish water species, the toad *Bufo melanostictus* and the tree frog *Rhacophorus maculatus.* During the monsoon, between June and September, the last two species occur almost all over the Sunderbans, except the southern part, facing the sea, The remaining species were noted in the peripheral areas of the Sunderbans.

The reptilian fauna included 10 species each of chelonians and lizards, 29 species of snakes and one species of crocodile. Of these, the common batagur *Batagur baska,* does not occur outside the Sarankhola Range of the Sunderbans Forest Division. Four species of marine turtles, *Chelonia mydas, Caretta caretta, Lepidochelys olivacea* and *Eretmochelys imbricata,* visit the sandy southern islands such as Katka, Supati, Nilkamal, Dubla and Putney. The other turtles occur in the north-eastern rivers and in the villages bordering the forests. The lizards belonged to five genera and four families. The house lizards, *Hemidactylus frenatus* and *H. brooki,* wall lizard *Gekko gecko,* and ring lizard *Varanus salvator* were found almost everywhere. The snakes belonged to 22 genera and nine families. The keelbacks, water snakes, cobra, sea snakes and pit vipers were commonly found in the Sunderbans, either inside the forest, or in the khals and rivers. Two rare species the rock python *Python molurus* and king cobra, *Opiophagus hannah* are represented by fairly good populations in the Sunderbans. The sand boa *Eryx conicus,* and the wart snake *Acrochordus granulatus* have been reported by Mukherjee (1975) from the West Bengal part of the Sunderbans. I presumed these to be present in our part too. The whitebellied mangrove snake *Fordonia leucobalia,* and glossy marsh snake *Gerardia prevostiana* and the Malacca sea snake. *Hydrophis caerulescens* have been seen so far in the Sunderbans only.

The estuarine or salt water crocodile *Crocodylus porosus,* occurs only in the Sunderbans. Although there is a single report of its occurrence in the coast of Cox's Bazar, eastern Bangladesh (Fr. R. W. Timm, pers. comm.). Hendrichs's (1975) report of the gharial *Gavialis gangeticus,* from the Sunderbans is possibly erroneus as it appears to be a purely freshwater species and no one else has seen it in the Sunderbans. The marsh crocodile, *Crocodylus palustris,* is possibly extinct from the Sunderbans and it occurs nowhere else in the country, excepting two small captive populations: 4-5 in a tank at Bagerhat, under Khulna district, and three in the only zoo of the country at Dhaka (Khan 1982c).

It is most likely that the reptilian list will expand once an extensive collection of lizards and snakes is made in the Sunderbans.

Of the 261 species of birds, recorded from the mangrove ecosystems, 14 have been taken from Hendrichs (1975) and Mukherjee (1975) and one from a Yale University collection reported by Ripley (1982). Altogether, 180 species of 105 genera and 32 families were non-passerine; 81 species of 50 genera and 19 families passerine. One hundred and sixty three species were resident and 98 migratory. All locally migratory and summer visitors have been considered under the resident category, as they breed either in the Sunderbans or elsewhere in the country. The non-passerines included 107 resident and 73 migratory species

So far 11 species of kingfishers have been reported from Bangladesh (Khan 1982a), of which eight are present in the Sunderbans. Out of these the brownwinged kingfisher *Pelargopsis amauroptera* and the ruddy kingfisher *Halcyon coromandra* were found only in the Sunderbans. Two other species, blackcapped and whitecollared kingfishers, *Halcyon pileata* and *H. chloris,* do not occur outside the mangrove ecosystems of the Sunderbans, Chakoria Sunderbans, coastal and the St. Martin's islands. The whitebellied and goliath herons, *Ardea insignis* & *A. goliath,* white stork *Ciconia ciconia,* whitebellied sea eagle *Haliaeetus leucogaster,* oriental hobby *Falco severus* & Indian skimmer *Rhynchops albicollis* (reported by Mukherjee 1975), swamp partridge *Francolinus gularis,* masked finfoot *Heliopais personata,* parasitic skua *Stercorarias parasiticus* (found in the Swatch-of-no-ground, at the Bay of Bengal), lesser & large crested terns *Sterna bengalensis* & *S. bergii* (reported by Mukherjee 1975), oystercatcher *Haematopus ostralegus,* avocet *Recurvirostra avosetta,* European starling *Sturnus vulgaris* (seen on St. Martin's Island), mangrove whistler *Pachycephala grisola* and orangebellied flowerpecker *Dicaeum trigonostigma* have so far been sighted in the mangrove formations.

There are many species of birds which are opportunistic in the sense that they roost inside the Sunderbans and other mangrove areas but gather food from the neighbouring areas, mostly cultivated fields, e.g. most of the mynas, parakeets, doves, pigeons, egrets, etc. These birds breed in the mangrove vegetations also. Many smaller species of passerine birds such as warblers and non-passerine charadriids could not be identified. Netting followed by specimen collection may reveal the presence of several more species, thereby raising the total figure to 300 or so, that means half of the Bangladesh avifauna.

The living mammals of the Sunderbans are represented by 42 species belonging to 37 genera and 22 families. In addition the crabeating macaque *Macaca fascicularis,* occurs in the mangrove formations of the River Naaf. The species of mammals which have disappeared in the recent past from the mangrove areas of Bangladesh include onehorned rhinoceros, *Rhinoceros unicornis*; smaller onehorned rhinoceros, *R. sondaicus*; wild buffalo *Bubalus bubalis*; swamp deer, *Cervus duvauceli*; hog deer, *Axis porcinus;* and the leopard, *Panthera pardus*. The royal Bengal tiger, *Panthera tigris* and chital, *Axis axis* have disappeared from the whole of Bangladesh, excepting the Kulna Sunderbans. Possibly the biggest populations of tiger, chital, rhesus macaque *Macaca mulatta*; smooth Indian otter *Lutra perspicillata* and wild boar *Sus scrofa* occur in the Sunderbans. The Irrawaddy dolphin, *Orcaella brevirostris*; shortfinned pilot whale, *Globicephala macrorhynchus;* finless porpoise *Neophocaena phocaenoides*; and the Malay dolphin *Stenella malayana* are rather restricted to the Sunderbans estuary.

Stratification pattern

In all, 15 species of mammals were terrestrial; 12 arboreal, including 11 species of flying mammals; 7 arbo-terrestrial (crabeating macaque also come under this category); 6 aquatic and two amphibious. All extinct mammals were terrestrial.

About 83 non-passerine species of birds were aquatic, 32 terrestrial, 30 shore-dwellers, 21 arboreal, 11 amphibious and 3 arbo-terrestrial. Twenty passerine species were terrestrial, 44 arboreal and 17 arbo-terrestrial.

Among the reptiles all the chelonians were aquatic, 4 lizards arboreal, two skinks and three monitor lizards were normally terrestrial and casually arboreal, 11 species of snakes were aquatic, 10 terrestrial, 3 arboreal, 3 arbo-terrestrial and 2 amphibians. The crocodile is amphibious too. The amphibians comprised 6 terrestrial and 2 aquatic species.

Out of the total, 112 species of wildlife of the mangrove ecosystem of Bangladesh gathered food from the aquatic environment, 89 from land, 84 from air and foliage, 30 from mud-, sand-flats, 36 from land, air and foliage and the remaining 17 from both water and land.

Feeding habits

Of the wildlife recorded from the mangrove ecosystem, 24 mammals were carnivorous, 11 herbivorous and 8 omnivorous; 157 non-passerine birds were carnivorous, 12 omnivorous and 11 herbivorous; 60 passerine species were carnivorous, 13 omnivorous and 8 herbivorous; 46 reptiles were carnivorous, and 4 omnivorous when 7 amphibians were carnivorous and one, *Rana hexadactyla,* almost invariably fed on dragon and damsel flies although some algal materials were found in the stomach. The presence of algal material in the stomach might be merely accidental.

A total of 294 species were carnivorous, including insectivores, piscivores and flesh-eaters; 38 omnivorous and 30 herbivorous, both folivorous and frugivorous.

International status

International Union for Conservation of Nature and Natural Resources (IUCN) defines endangered species as those in danger of extinction and whose continued survial is unlikely if the casual factors continue operating. The common batagur, green turtle, olive ridley turtle, hawksbill turtle, rock python, peregrine falcon, royal Bengal tiger and leopard of the mangrove ecosystems are endangered so far as the Red Data Book (RDB) of IUCN is concerned. The RDB has included the estuarine crocodile as a vulnerable species, meaning that this species is believed likely to become extinct in the near future if the adverse casual factors continue operating.

Schedule I of the Convention on International Trade in Endangered Species of Wild Fauna & Flora (CITES) includes 7 turtles and tortoises, Bengal and yellow lizards, rock python, white stork, spotted green shank, Ganges river dolphin, finless porpoise, royal Bengal tiger and leopard cat. Another seven species — ring lizard, marsh crocodile, rhesus macaque, smooth Indian and clawless otters, fishing and jungle cats — are in Schedule II of the CITES.

Population estimation

Hendrichs (1975) for the first time attempted estimating the populations of tiger, otter, wild boar, chital, rhesus macaque and some other vertebrates and invertebrates of the Khulna Sunderbans. Gittins (1981), and Khan & Ahsan (1981) attempted estimating the population of the rhesus macaque, while I have made an attempt to provide a rough estimate of the spotted deer (chital).

Hendrichs (1975) estimated the total population of the tiger in the Sunderbans to be 350, otter 20000, wild boar 20000; chital 80000 and rhesus macaque 40000. His estimated density of these were tiger — 0.1/km^2, otter — 5/km^2, boar 5/km^2, chital — 20/km^2 and macaque — 10/km^2. Gittins (1981) noted 2.6 groups of macaques with 20 individuals in each group, that is a density of 52/km^2. He has estimated the total population of macaque in 2274-km^2 of natural forests to be 118,248, and another 7972 in 1533-km^2 scrub forest of the Sunderbans. In the scrub forest the density of the macaque was 5.2/km^2.

Ahsan and I covered 608 km linear distance, equivalent to 20.83 km^2 of transects, where we encountered 1.58 groups/km^2 with 17.05 macaques/km^2 and the total population was estimated to be 68,200 in an area of about 4000 km^2. The population estimation done by the three authorities showed much variation. Our estimation of 68,200 macaques is much nearer to Hendrich's 40,000 than Gittins' 126,220.

In the 608 km of linear distance and 15.2 km^2 of transects which we covered we encountered 200 deer. The density of chital was 13.15/km^2. The Sunderbans, therefore, supports an estimated 52,600 deer. This is 34.25% less than the estimated population given by Hendrichs (1975). But the difference is close to his 25% range of deviation. This difference is mainly because he devoted more time and covered each of his sampling areas in great detail, which we could not do because of lack of time and logistic support.

RECOMMENDATIONS

The Government of Bangladesh has already gazetted three areas of the Sunderbans mangrove forest as wildlife sanctuaries. These are the East, West and South Wildlife Sanctuary, consisting of compartments no. 6 (54 km^2), part of no. 54 (90 km^2), and part of no. 43 and the whole of no. 44 (177 km^2) respectively. Unfortunately, these declarations have paid little or no attention to the earlier recommendations made by several expeditions and an enquiry committee meetings by the experts of FAO, IUCN, WWF and the Government Forest Department, *viz.*, Mountfort & Poore 1968, Seidensticker and Hai 1978, and Oliver

1979. Although these recommendations were based on sound ecological considerations.

To save the wildlife from extinction, to stop appreciable changes in the mangrove ecosystem, and to make the already declared sanctuaries meaningful so that these support viable populations of wildlife I strongly recommend that:

1. Compartment no. 3 to 8, 11, 12 and 45 be declared as the Sunderbans National Park, incorporating the existing East Sanctuary;
2. The remaining portion of the Compartment no. 43 be added to the existing South Sanctuary;
3. Instead of West Sanctuary a new one be declared in the North, comprising compartments no. 30 to 33;
4. The sanctuaries/national parks be sufficiently manned by technical staff so that they can monitor the faunal and floral changes year round.
5. Cheaper tourist facilities be developed to compensate the revenue lost due to discontinuation of forestry practises.

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APPENDIX I

CHECKLIST OF THE WILDLIFE OF BANGLADESH MANGROVE ECOSYSTEMS

Sl. No.	Scientific name	Common name
		AMPHIBIA
1.	*Bufo melanostictus*	Common Toad
2.	*Microhyla ornata*	Ornate Microhylid
3.	*Rana hexadactyla*	Pond/Green Frog
4.	*Rana cyanophlyctis*	Skipper Frog
5.	*Rana tigerina*	Indian Bull Frog
6.	*Rana limnocharis*	Cricket Frog
7.	*Rana temporalis*	..
8.	*Polypedates maculatus*	Maculated Tree Frog
		REPTILIA
9.	*Batagur baska*	Common Batagur/Tuntong
10.	*Kachuga tecta*	Roofed Turtle
11.	*Melanochelys tricarinata*	Threekeeled Land Tortoise
12.	*Morenia petersi*	Yellow Turtle
13.	*Lissemys punctata*	Spotted Flap Shell
14.	*Pelochelys bibroni*	Bibron's Soft Shell
15.	*Chelonia mydas*	Green Turtle
16.	*Caretta caretta*	Loggerhead Turtle
17.	*Lepidochelys olivacea*	Olive Ridley Turtle
18.	*Eretmochelys imbricata*	Hawksbill Turtle
19.	*Hemidactylus brooki*	House Lizard
20.	*Hemidactylus flaviviridis*	Common House Lizard
21.	*Hemidactylus frenatus*	Common House Lizard
22.	*Gekko gecko*	Wall Lizard
23.	*Calotes versicolor*	Garden Lizard
24.	*Mabuya dissimilis*	Skink
25.	*Mabuya carinata*	Common Skink
26.	*Varanus bengalensis*	Bengal/Grey Lizard
27.	*Varanus salvator*	Ring/Monitor Lizard
28.	*Varanus flavescens*	Yellow/Common Lizard
29.	*Typhlina porrectus*	Slender Worm Snake
30.	*Python molurus*	Rock Python
31.	*Eryx conicus*	Common Sand Boa
32.	*Lycodon aulicus*	Common Wolf Snake
33.	*Amphiesma stolata*	Striped Keelback
34.	*Xenochrophis piscator*	Checkered Keelback
35.	*Xenochrophis cerasogaster*	Darkbellied Marsh Snake
36.	*Atretium schistosum*	Olive Keelback
37.	*Acrochordus granulatus*	File/Wart Snake
38.	*Ptyas mucosus*	Rat Snake/Dhaman
39.	*Dendrelaphis tristis*	Common Bronzeback Tree Snake
40.	*Ahaetulla nasutus*	Common Vine Snake
41.	*Enhydris enhydris*	Common Smooth Water Snake

Sl. no.	Scientific name	Common name
42.	*Cerberus rhynchops*	Dogfaced Water Snake
43.	*Gerardia prevostiana*	Glossy Marsh Snake
44.	*Fordonia leucobalia*	Whitebellied Mangrove Snake
45.	*Bungarus caeruleus*	Common Krait
46.	*Bungarus fasciatus*	Banded Krait
47.	*Naja naja*	Monocellate/Bengal Cobra
48.	*Ophiophagus hannah*	King Cobra
49.	*Enhydrina schistosa*	Hooknosed Sea Snake
50.	*Hydrophis nigrocinctus*	Blackheaded Sea Snake
51.	*Hydrophis obscurus*	Estuarine Sea Snake
52.	*Hydrophis caerulescens*	Malacca Sea Snake
53.	*Microcephalophis gracilis*	Common Narrowheaded Sea Snake
54.	*Microcephalophis cantoris*	Cantor's Narrowheaded Sea Snake
55.	*Vipera russelli*	Russell's Viper
56.	*Trimeresurus gramineus*	Bamboo Pit Viper
57.	*Trimeresurus erythrurus*	Spot-tailed Pit Viper
58.	*Crocodylus porosus*	Estuarine/Saltwater Crocodile

AVES: Non-passerine birds

			Status
59.	*Podiceps ruficollis*	Little Grebe/Dabchick	R (resident)
60.	*Pelicanus onocrotalus*	White/Rosy Pelican	M(migratory)
61.	*Phalacrocorax niger*	Little Cormorant	R
62.	*Anhinga rufa*	Darter/Snakebird	R
63.	*Ardea insignis*	Great Whitebellied Heron	R
64.	*Ardea goliath*	Goliath/Giant Heron	M
65.	*Ardea cinerea*	Grey Heron	R
66.	*Ardea purpurea*	Purple Heron	R
67.	*Ardea alba*	Large Egret	R
68.	*Ardeola grayii*	Pond Heron/Paddy Bird	R
69.	*Ardeola striatus*	Little Green Heron	R
70.	*Bubulcus ibis*	Cattle Egret	R
71.	*Egretta intermedia*	Median/Intermediate Egret	R
72.	*Egretta garzetta*	Little Egret	R
73.	*Nycticorax nycticorax*	Night Heron	R
74.	*Gorsachius melanolophus*	Malay/Tiger Bittern	R
75.	*Ixobrychus minutus*	Little Bittern	R
76.	*Ixobrychus cinnamomeus*	Chestnut Bittern	R
77.	*Ixobrychus flavicollis*	Black Bittern	R
78.	*Mycteria leucocephala*	Painted Stork	R
79.	*Anastomus oscitans*	Openbill Stork	R
80.	*Ciconia episcopus*	Whitenecked Stork	R
81.	*Ciconia ciconia*	White Stork	M
82.	*Leptoptilos dubius*	Greater Adjutant Stork*	R
83.	*Leptoptilos javanicus*	Lesser Adjutant	R

* possibly extinct now.

Sl. no.	Scientific name	Common name	Status
84.	*Threskiornis aethiopica*	White Ibis	R
85.	*Anser fabalis*	Bean/Pinkfooted Goose	M
86.	*Anser anser*	Grey Lag Goose	M
87.	*Anser indicus*	Barheaded Goose	M
88.	*Dendrocygna javanica*	Lesser Whistling Teal	R
89.	*Tadorna ferruginea*	Ruddy Shelduck	M
90.	*Anas acuta*	Pintail	M
91.	*Anas crecca*	Common Teal	M
92.	*Anas platyrhynchos*	Mallard	M
93.	*Anas strepera*	Gadwall	M
94.	*Anas penelope*	Wigeon	M
95.	*Anas clypeata*	Shoveller	M
96.	*Anas querquedula*	Ganganey	M
97.	*Netta rufina*	Redcrested Pochard	M
98.	*Aythya ferina*	Common Pochard	M
99.	*Aythya nyroca*	White-eyed Pochard	M
100.	*Aythya fuligula*	Tufted Duck	M
101.	*Nettapus coromandelianus*	Cotton Teal	R
102.	*Elanus caeruleus*	Blackwinged Kite	R
103.	*Pernis ptilorhynchus*	Honey Buzzard	R
104.	*Milvus migrans*	Pariah Kite	R
105.	*Haliastur indus*	Brahminy Kite	R
106.	*Accipiter badius*	Shikra	R
107.	*Buteo rufinus*	Longlegged Buzzard	M
108.	*Buteo buteo*	Buzzard	M
109.	*Aquila rapax*	Tawny Eagle	M
110.	*Aquila pomarina*	Lesser Spotted Eagle	M
111.	*Haliaeetus leucogaster*	Whitebellied Sea Eagle	R
112.	*Haliaeetus leucoryphus*	Pallas's Fishing Eagle	R
113.	*Icthyophaga ichthyaetus*	Greyheaded Fishing Eagle	R
114.	*Gyps bengalensis*	Whitebacked Vulture	R
115.	*Circus macrourus*	Pale Harrier	M
116.	*Circus melanoleucos*	Pied Harrier	M
117.	*Circus aeruginosus*	Marsh Harrier	M
118.	*Circaetus gallicus*	Short-toed Eagle	R
119.	*Spilornis cheela*	Crested Serpent Eagle	R
120.	*Pandion haliaetus*	Osprey	M
121.	*Falco peregrinus*	Peregrine Falcon	M
122.	*Falco subbuteo*	Hobby	R
123.	*Falco chiquera*	Redheaded Merlin	R
124.	*Falco tinnunculus*	Kestrel	M
125.	*Francolinus gularis*	Swamp Partridge	R
126.	*Gallus gallus*	Red Jungle Fowl	R
127.	*Rallus aquaticus*	Water Rail	M
128.	*Porzana fusca*	Ruddy Crake	R
129.	*Amaurornis phoenicurus*	Whitebreasted Water Hen	R
130.	*Gallicrex cinerea*	Water Cock	R

Sl. no.	Scientific name	Common name	Status
131.	*Porphyrio porphyrio*	Moorhen	R
132.	*Fulica atra*	Coot	R
133.	*Heliopais personata*	Masked Finfoot	R
134.	*Hydrophasianus chirurgus*	Pheasant-tailed Jacana	R
135.	*Metopidius indicus*	Bronzewinged Jacana	R
136.	*Haematopus ostralegus*	Oystercatcher	R
137.	*Rostratula benghalensis*	Painted Snipe	R
138.	*Himantopus himantopus*	Blackwinged Stilt	R
139.	*Recurvirostra avosetta*	Avocet	M
140.	*Glareola lactea*	Small Indian Pratincole	R
141.	*Vanellus cinereus*	Greyheaded Lapwing	M
142.	*Vanellus indicus*	Redwattled Lapwing	R
143.	*Vanellus spinosus*	Spurwinged Lapwing	R
144.	*Pluvialis dominica*	Eastern Golden Plover	M
145.	*Charadrius hiaticula*	Ringed Plover	M
146.	*Charadrius dubius*	Little Ringed Plover	M
147.	*Charadrius alexandrinus*	Kentish Plover	M
148.	*Charadrius placidus*	Longbilled Ringed Plover	M
149.	*Charadrius mongolus*	Mongolian Plover	M
150.	*Numenius phaeopus*	Whimbrel	M
151.	*Numenius arquata*	Curlew	M
152.	*Limosa limosa*	Blacktailed Godwit	M
153.	*Tringa erythropus*	Spotted Red Shank	M
154.	*Tringa totanus*	Common Red Shank	M
155.	*Tringa stagnatilis*	Marsh Sandpiper	M
156.	*Tringa nebularia*	Green Shank	M
157.	*Tringa ochropus*	Green Sandpiper	M
158.	*Tringa glareola*	Wood Sandpiper	M
159.	*Tringa terek*	Terek Sandpiper	M
160.	*Tringa hypoleucos*	Common Sandpiper	M
161.	*Arenaria interpres*	Turnstone	M
162.	*Limnodromus semipalmatus*	Snipebilled Godwit	M
163.	*Gallinago stenura*	Pintail Snipe	M
164.	*Gallinago gallinago*	Fantail Snipe	M
165.	*Calidris tenuirostris*	Eastern Knot	M
166.	*Calidris alba*	Sanderling	M
167.	*Calidris minuta*	Little Stint	M
168.	*Calidris temminckii*	Temminck's Stint	M
169.	*Calidris alpina*	Dunlin	M
170.	*Calidris testacea*	Curlew-Sandpiper	M
171.	*Philomachus pugnax*	Ruff and Reeve	M
172.	*Stercorarius parasiticus*	Parasitic Skua/Jaegar	M
173.	*Larus argentatus*	Herring Gull	M
174.	*Larus ichthyaetus*	Great Blackheaded Gull	M
175.	*Larus brunnicephalus*	Brownheaded Gull	M
176.	*Larus ridibundus*	Blackheaded Gull	M
177.	*Chlidonias hybrida*	Whiskered Tern	M

Sl. no.	Scientific name	Common name	Status
178.	*Chlidonias leucopterus*	Whitewinged Black Tern	M
179.	*Gelochelidon nilotica*	Gullbilled Tern	R
180.	*Hydroprogne caspia*	Caspian Tern	M
181.	*Sterna aurantia*	Indian River Tern	R
182.	*Sterna hirundo*	Common Tern	M
183.	*Sterna acuticauda*	Blackbilled Tern	R
184.	*Sterna fuscata*	Sooty Tern	M
185.	*Sterna albifrons*	Little Tern	R
186.	*Sterna bergii*	Large Crested Tern	R
187.	*Sterna bengalensis*	Lesser Crested Tern	R
188.	*Rhynchops albicollis*	Indian Skimmer	R
189.	*Treron pompadora*	Greyfronted Green Pigeon	R
190.	*Treron phoenicoptera*	Green Pigeon	R
191.	*Columba livia*	Blue Rock Pigeon	R
192.	*Streptopelia orientalis*	Rufous Turtle Dove	M
193.	*Streptopelia decaocto*	Ring Dove	R
194.	*Streptopelia tranquebarica*	Red Turtle Dove	R
195.	*Streptopelia chinensis*	Spotted Dove	R
196.	*Psittacula krameri*	Roseringed Parakeet	R
197.	*Psittacula finschii*	Slatyheaded Parakeet	R
198.	*Clamator jacobinus*	Pied Crested Cuckoo	R
199.	*Cuculus varius*	Brainfever Bird	R
200.	*Cuculus micropterus*	Indian Cuckoo	R
201.	*Cacomantis sonneratii*	Banded Bay Cuckoo	R
202.	*Cacomantis merulinus*	Rufousbellied Plaintive Cuckoo	R
203.	*Eudynamys scolopacea*	Koel	R
204.	*Rhopodytes tristis*	Large Greenbilled Malkoha	R
205.	*Centropus sinensis*	Crow-Pheasant/Coucal	R
206.	*Tyto alba*	Barn Owl	R
207.	*Otus scops*	Scops Owl	R
208.	*Otus bakkamoena*	Collared Scops Owl	R
209.	*Bubo bubo*	Eagle-Owl/Great Horned Owl	R
210.	*Bubo zeylonensis*	Brown Fish Owl	R
211.	*Bubo flavipes*	Tawny Fish Owl	R
212.	*Ninox scutulata*	Brown Hawk-Owl	R
213.	*Athene brama*	Spotted Owlet	R
214.	*Asio flammeus*	Shorteared Owl	M
215.	*Caprimulgus indicus*	Jungle Nightjar	R
216.	*Caprimulgus macrurus*	Longtailed Nightjar	R
217.	*Cypsiurus parvus*	Palm Swift	R
218.	*Ceryle rudis*	Lesser Pied Kingfisher	R
219.	*Alcedo atthis*	Common Kingfisher	R
220.	*Pelargopsis amauroptera*	Brownwinged Kingfisher	R
221.	*Pelargopsis capensis*	Storkbilled Kingfisher	R
222.	*Halcyon coromandra*	Ruddy Kingfisher	R
223.	*Halcyon pileata*	Blackcapped Kingfisher	R
224.	*Halcyon smyrnensis*	Whitebreasted Kingfisher	R
225.	*Halcyon chloris*	Whitecollared Kingfisher	R

Sl. no.	Scientific name	Common name	Status
226.	*Merops orientalis*	Green Bee-eater	R
227.	*Coracias benghalensis*	Indian Roller/Blue Jay	R
228.	*Upupa epops*	Hoopoe	R
229.	*Megalaima lineata*	Lineated Barbet	R
230.	*Megalaima haemacephala*	Coppersmith	R
231.	*Jynx torquilla*	Wryneck	M
232.	*Micropternus brachyurus*	Rufous Woodpecker	R
233.	*Picus myrmecophoneus*	Little Scalybellied Green Woodpecker	R
234.	*Dinopium beughalense*	Lesser Goldenbacked Woodpecker	R
235.	*Picoides macei*	Fulvousbreasted Pied Woodpecker	R
236.	*Picoides mahrattensis*	Yellowfronted Pied Woodpecker	R
237.	*Picoides nanus*	Pigmy Woodpecker	R
238.	*Chrysocolaptes lucidus*	Larger Goldenbacked Woodpecker	R
		AVES: Passerine birds	
239.	*Mirafra assamica*	Bush Lark	R
240.	*Alauda gulgula*	Eastern Skylark	R
241.	*Hirundo rustica*	Common Swallow	M
242.	*Hirundo daurica*	Redrumped/Striated Swallow	M
243.	*Lanius schach*	Blackheaded/Rufous Shrike	R
244.	*Lanius cristatus*	Brown Shrike	M
245.	*Oriolus xanthornus*	Blackheaded Oriole	R
246.	*Dicrurus adsimilis*	Black Drongo	R
247.	*Dicrurus leucophaeus*	Grey/Ashy Drongo	M
248.	*Dicrurus aeneus*	Bronzed Drongo	M
249.	*Dicrurus paradiseus*	Greater Racket-tailed Drongo	R
250.	*Artamus fuscus*	Ashy-Swallow Shrike	R
251.	*Sturnus malabaricus*	Greyheaded Myna	R
252.	*Sturnus vulgaris*	Starling	M
253.	*Sturnus contra*	Pied Myna	R
254.	*Acridotheres tristis*	Common Myna	R
255.	*Acridotheres ginginianus*	Bank Myna	R
256.	*Acridotheres fuscus*	Jungle Myna	R
257.	*Dendrocitta vagabunda*	Tree Pie	R
258.	*Corvus splendens*	House Crow	R
259.	*Corvus macrorhynchos*	Jungle Crow	R
260.	*Tephrodornis pondicerianus*	Common Wood Shrike	R
261.	*Coracina novaehollandiae*	Large Cuckoo-Shrike	R
262.	*Coracina melaschistos*	Smaller Grey Cuckoo-Shrike	M
263.	*Coracina melanoptera*	Blackheaded Cuckoo Shrike	M
264.	*Pericrocotus cinnamomeus*	Small Minivet	R
265.	*Aegithina tiphia*	Common Iora	R
266.	*Chloropsis aurifrons*	Goldfronted Chloropsis	R
267.	*Pycnonotus melanicterus*	Blackheaded Yellow Bulbul	R
268.	*Pycnonotus jocosus*	Redwhiskered Bulbul	R
269.	*Pycnonotus cafer*	Redvented Bulbul	R
270.	*Pellorneum ruficeps*	Spotted Babbler	R
271.	*Trichastoma abotti*	Abott's Babbler	R

Sl. no.	Scientific name	Common name	Status
272.	*Turdoides striatus*	Jungle Babbler	R
273.	*Alcippe poioicephala*	Quaker Babbler	R
274.	*Muscicapa parva*	Redbreasted Flycatcher	M
275.	*Muscicapa rubeculoides*	Bluethroated Flycatcher	M doubtful
276.	*Muscicapa thalassina*	Verditer Flycatcher	M
277.	*Culicicapa ceylonensis*	Greyheaded Flycatcher	R
278.	*Rhipidura albicollis*	Whitethroated Fantail Flycatcher	R
279.	*Terpsiphone paradisi*	Paradise Flycatcher	R
280.	*Hypothymis azurea*	Blacknaped Flycatcher	R
281.	*Pachycephala grisola*	Mangrove Whistler	R
282.	*Bradypterus luteoventris*	Brown Bush Warbler	M
283.	*Cisticola exilis*	Fantail Warbler	R
284.	*Cisticola juncidis*	Streaked Fantail Warbler	R
285.	*Prinia hodgsoni*	Franklin's Wren-Warbler	R
286.	*Prinia socialis*	Ashy Wren-Warbler	R
287.	*Orthotomus sutorius*	Tailor Bird	R
288.	*Acrocephalus stentorius*	Great Reed Warbler	M
289.	*Acrocephalus dumetorum*	Blyth's Reed Warbler	M
290.	*Phylloscopus affinis*	Tickell's Leaf Warbler	M
291.	*Erithacus svecicus*	Blue Throat	M
292.	*Copsychus saularis*	Magpie-Robin (National Bird)	R
293.	*Phoenicurus ochruros*	Black Redstart	M
294.	*Saxicola torquata*	Collared Bush Chat	M
295.	*Saxicola caprata*	Pied Bush Chat	R
296.	*Monticola solitarius*	Blue Rock Thrush	M
297.	*Zoothera citrina*	Orangeheaded Ground Thrush	M
298.	*Turdus ruficollis*	Redthroated Thrush	M
299.	*Parus major*	Grey Tit	R
300.	*Sitta castanea*	Chestnutbellied Nuthatch	R
301.	*Sitta frontalis*	Velvetfronted Nuthatch	R
302.	*Anthus hodgsoni*	Indian Tree Pipit	M
303.	*Anthus novaeseelandiae*	Paddyfield Pipit	M
304.	*Motacilla flava*	Yellow Wagtail	M
305.	*Motacilla citreola*	Yellowheaded Wagtail	M
306.	*Motacilla cinerea*	Grey Wagtail	M
307.	*Motacilla alba*	White Wagtail	M
308.	*Dicaeum trigonostigma*	Ornagebellied Flowerpecker	R
309.	*Dicaeum erythrorhynchos*	Tickell's Flowerpecker	R
310.	*Dicaeum cruentatum*	Scarletbacked Flowerpecker	R
311.	*Nectarinia zeylonica*	Purplerumped Sunbird	R
312.	*Nectarinia asiatica*	Purple Sunbird	R
313.	*Zosterops palpebrosa*	White-eye	R
314.	*Passer domesticus*	House Sparrow	R
315.	*Ploceus philippinus*	Baya/Weaver Bird	R
316.	*Ploceus manyar*	Streaked Weaver Bird	R
317.	*Lonchura malabarica*	Common Silverbill	R
318.	*Lonchura striata*	Whitebacked Munia	R
319.	*Lonchura punctulata*	Spotted Munia	R

Sl. no.	Scientific name	Common name
		MAMMALIA
320.	*Suncus murinus*	Grey Musk Shrew
321.	*Pteropus giganteus*	Flying Fox
322.	*Rousettus leschenaultii*	Fulvous Fruit Bat
323.	*Cynopterus sphinx*	Shortnosed Fruit Bat
324.	*Rhinopoma hardwickei*	Lesser Rat-tailed Bat
325.	*Taphozous saccolaimus*	Pouchbearing Sheathtailed Bat
326.	*Megaderma lyra*	False Vampire
327.	*Coelops frithi*	Tailless Leafnosed Bat
328.	*Pipistrellus mimus*	Indian Pygmy Pipistrelle
329.	*Pipistrellus coromandra*	Indian Pipistrelle
330.	*Hesperoptenus tickelli*	Tickell's Bat
331.	*Scotophilus temmincki*	Lesser Yellow Bat
332.	*Macaca mulatta*	Rhesus Macaque
333.	*Macaca fascicularis*	Crabeating Macaque
334.	*Canis aureus*	Jackal
335.	*Lutra perspicillata*	Smooth Indian Otter
336.	*Aonyx cinerea*	Clawless Otter
337.	*Viverra zibetha*	Large Indian Civet
338.	*Viverricula indica*	Small Indian Civet
339.	*Paradoxurus hermaphrodites*	Palm Civet/Toddy Cat
340.	*Herpestes auropunctatus*	Small Mongoose
341.	*Herpestes edwardsi*	Common Mongoose
342.	*Panthera tigris*	Royal Bengal Tiger (National Animal)
343.	*Panthera pardus*	Leopard/Panther (extinct)
344.	*Felis bengalensis*	Leopard-Cat
345.	*Felis viverrina*	Fishing Cat
346.	*Felis chaus*	Jungle Cat
347.	*Rhinoceros unicornis*	Onehorned Rhinoceros (extinct)
348.	*Rhinoceros sondaicus*	Smaller Onehorned Rhinoceros (extinct)
349.	*Bubalus bubalis*	Wild Buffalo (extinct)
350.	*Cervus duvauceli*	Swamp Deer/Barasingha (extinct)
351.	*Axis porcinus*	Hog Deer (extinct)
352.	*Axis axis*	Chital/Spotted Deer
353.	*Muntiacus muntjac*	Barking Deer/Muntjac
354.	*Sus scrofa*	Wild Boar
355.	*Lepus nigricollis*	Rufoustailed Hare
356.	*Funambulus pennanti*	Fivestriped Palm Squirrel
357.	*Bandicota bengalensis*	Lesser Bandicoot
358.	*Bandicota indica*	Bandicoot Rat
359.	*Mus booduga*	Indian Porcupine
360.	*Mus musculus*	House Mouse
361.	*Rattus rattus*	Common House Rat
362.	*Hystrix indica*	Indian Poroupine
363.	*Orcaella brevirostris*	Irrawaddy Dolphin
364.	*Globicephala macrorhynchus*	Shortfinned Pilot Whale
365.	*Peponocephala electra*	Broadbeaked/Melonheaded Dolphin
366.	*Neophocaena phocaenoides*	Finless/Little Porpoise
367.	*Stenella malayana*	Malay Dolphin
368.	*Platanista gangetica*	Ganges Susu/River Dolphin

DRUG IMMOBILISATION OF INDIAN ELEPHANT[1]

J. B. SALE[2], V. RISHI[3], K. N. SINGH[4] AND V. K. VERMA[5]

(*With a plate*)

Critical data from the drug immobilisation of six adult wild elephants in U.P. in 1983-84, using Immobilon (etorphine/acepromazine) and Revivon (diprenorphine) are reported. A standard Distinject N60 powder rifle and accessories was used for darting, with the addition of a "radio-dart" in three cases. Complete recumbancy was achieved using doses of 3.0 to 3.5 ml Immobilon (7.4-8.6 mg etorphine, 30-35 mg acepromazine). Induction times varied between 15 and 35 minutes; "down" times between 30 and 324 minutes and revival times between 4 and 41 minutes.

INTRODUCTION

Drug immobilisation has been routinely employed for the capture of the African elephant (*Loxondonta africana*) since the mid-sixties and many reports on methodology and dosages exist in the literature (Young 1973, Harthoorn 1976). There are several reports on the use of this method with the Asiatic elephant (*Elephas maximus*) in Malaysia (Jainudeen and Khan 1977, Jainudeen *et al.* 1971) and Sri Lanka (Jones 1975, Hofmeyr 1979). In India drug immobilisation of elephants using the powerful morphine derivative etorphine hydrochloride or "M. 99", has been reported in two isolated cases only: one in Orissa (Choudhury & Patnaik 1982), and one in West Bengal (Ghosh 1982) which produced rather atypical results.

The method has a number of potential uses in the context of elephant management in India. If used to capture elephants for domestication, in addition to being highly selective, it has the advantage of causing less disturbance to the wild herds than traditional methods such as mela shikar or khedda. In a well planned immobilisation operation the candidate can be put to sleep without ever being aware of the presence of the capture team. For dealing with crop raiders or rogues the method allows a rapid and safe capture of the culprit and subsequent translocation to a new release area or captivity. This has been achieved successfully in Malaysia (Jainudeen and Khan, l.c.). Similarly, the temporary immobilisation of a sick animal for examination and treatment can be achieved with a minimum of distress to the patient.

In the light of the above, we present information on six drug immobilisations of wild elephants, carried out during the preliminary phase of a radio-tracking study of elephant habitat utilization in Rajaji Sanctuary in northwestern U.P., in 1983-84. The aim in each case was to fix a radio-collar to the immobilised animal and release it as quickly as

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possible. However, the details of the procedure would apply equally well to any situation where drug immobilisation of elephants was being attempted.

METHODS

All six animals were darted with Immobilon (Reckitt & Colman, Hull, U.K.), a mixture containing 2.45 mg/ml of the narcotic etorphine hydrochloride and 10 mg/ml acepromazine maleate. The antagonist used was Revivon (Reckitt) which contains 3.0 mg/ml diprenorphine hydrochloride and is a specific antidote for etorphine. The acepromazine is not antagonised and has a residual tranquilising effect on the animal after it is remobilised. (Immobilon has been widely used in the immobilisation of African elephants and to a limited extent on the Asiatic elephant.)

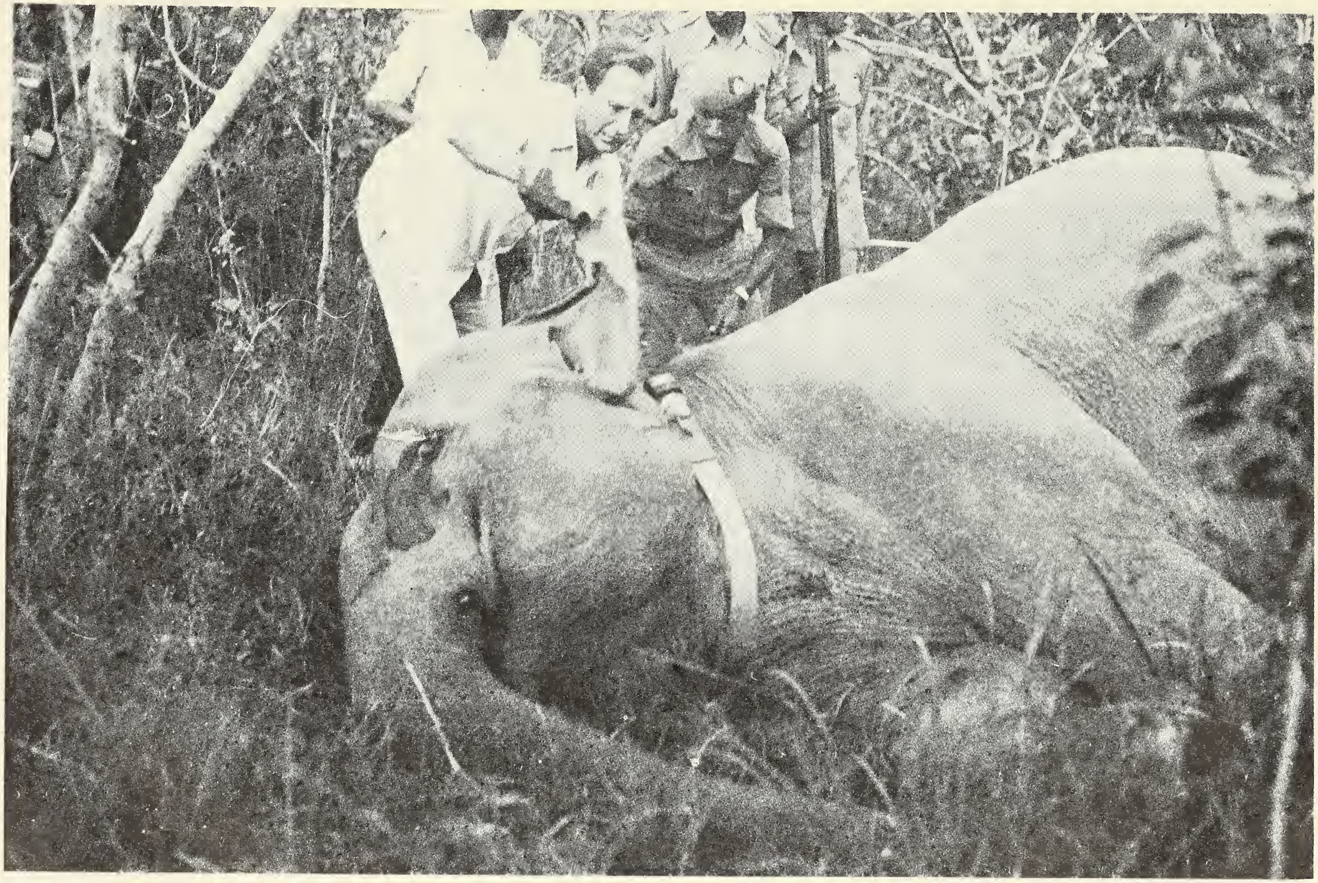
Particular care was taken to ensure that an antidote to etorphine suitable for use in humans was readily available whenever this highly dangerous drug was being carried in the field. A clearly labelled 'human' pack containing six 1 ml vials of Narcan injection of naloxone hydrochloride 0.4 mg/ml (Wintrop Laboratories, Surbiton, U.K.), a sterile 2 ml syringe and needles was always to hand, in case of accidental administration of Immobilon to a person. It was also ensured that at least two members of a capture team were conversant with the procedure for administration of the antidote should a human emergency arise.

The immobilising solution was darted into the elephants, using a Distinject N60 powder rifle and accessories (Peter Ott & Co., Basel, Switzerland). A 3 or 4 ml aluminium syringe barrel was employed and fitted with a standard Distinject NM6 needle, 63 mm long and 2 mm in diameter. This had a side hole 8 mm from the tip, in addition to a terminal hole, and a retention collar 29 mm from the tip. In three cases the dart used had a standard Distinject feathered stabiliser (flight), while in the other three a "radio-dart" was fitted. This consisted of a dart made for the Cap-Chur gun (Wildlife Materials Inc. Carbondale, Illinois, U.S.A.), modified by the replacement of the Cap-Chur stabiliser with a Distinject stabiliser which was found to give better flight characteristics.

In cases where a standard dart was employed, the prescribed 0.22 blank charge for the syringe size/distance involved was used, as per the chart provided by the manufacturers of the Distinject equipment. Likewise, the variable rear sight of the rifle was set as per the chart. When using a radio-dart, however, the most powerful (orange) charge was selected irrespective of distance and the sight setting adjusted to compensate for the additional weight of the radio transmitter in the rear of the dart.

Tracking of the radio-dart signals was achieved using a Wildlife Materials Inc. TRX 6 receiver fitted with a collapsible hand-held Yagi antenna. Radio frequencies of the transmitter-receiver systems were in the range of 150-151 MHz.

Candidate elephants for immobilisation were carefully approached on a domestic elephant in five cases and on foot in the sixth case. The aim was to fire the dart high into the hind quarters of the candidate from a distance of between 30 and 45 m. A dart sited high in the rear of an elephant is less likely to get dislodged by vegetation as the animal moves away, than one placed lower down or in the side of the animal. Darts lodged in the shoulder region are sometimes quickly removed by the animal, using its trunk, making



Adult female (Case No. 3) immobilised in safe lateral recumbancy, during radio-collaring operation. (*Photo:* V. K. Verma)

subsequent visual identification or radio-tracking of the darted individual impossible.

Every effort was made to disturb the candidate individual and its companions, where present, as little as possible prior to firing the dart. In some cases the individual was apparently totally unaware of the approach of the domestic elephant. This was also true in the case of the individual darted on foot, where the shot was fired from a tree, 4 m above the ground. Similarly, after firing the aim was not to harass the darted animal but merely to keep it in view from a distance — an extremely difficult objective to achieve in the mixed deciduous forest of the Rajaji Sanctuary.

Revivon was normally injected into a large vein in the ear, when the animal was ready for release. In one case, however, due to the partial natural recovery of the elephant making close approach difficult, the antidote was fired into the lower shoulder with a dart. (The dart was pulled out by the animal, using its trunk, shortly after revival.)

RESULTS

Details of the six immobilisations under consideration are shown in Table 1. All individuals were fully adult and complete recumbancy was achieved in five cases, using doses of between 3.0 and 3.5 ml Immobilon, equivalent to 7.4-8.6 mg etorphine and 30-35 mg acepromazine respectively. The sixth case (No. 4 in Table 1) received only a partial dose of Immobilon (1.75 ml = 4.3 mg etorphine and 17.5 mg acepromazine) as a result of malfunction of the dart and, although immobilised, full recumbancy was not achieved.

Induction times (time from darting to going down) varied between 15 and 35 minutes in the four cases where they were ascertained. Animal No. 4 which received the smallest dose (1.75 ml) took 35 minutes to reach only partial recumbancy. However, the series is too small to provide definite conclusions about a possible relationship between dosage and induction time. In any case, there are a number of other factors which influence rate of induction, such as needle site, angle of entry and state of alertness of the animal prior to darting.

With all uses of immobilising drugs an important aim is to revive the animal as quickly as possible. With very heavy species such as elephant and rhino it is particularly important to minimise the time the animal is in a recumbant posture. Elephants in particular should not be left in sternal recumbancy for more than about 20 minutes. With these considerations in mind, Table 1 shows the time individuals were "down" (Range 30-324 minutes). This is the time that elapsed between the animal going down (induction) and getting up (revival). In cases where either time is not known a "maximum" time down is indicated which is either the time between darting and revival (Cases 3 and 6) or induction and the observation of the already revived (standing) animal (Case No. 4). Actual time down is in all likelihood appreciably less than maximum time in all three cases.

In this series of immobilisations the animals were given Revivon as soon as the radio-collar had been fitted, except in Cases 4 and 6. Where the animal was found before induction it was possible to complete the operation and get it on its feet within between 30 and 44 minutes, some 10 minutes of which was "waiting time" allowed for the drug effect to deepen prior to disturbing the animal by handling.

"Down" time in Case No. 6 was extremely long, the malfunctioning of the radio-dart resulting in a big delay in locating the elephant.

TABLE 1

DATA ON SIX DRUG IMMOBILISATIONS OF WILD ELEPHANTS IN U.P.

Case			Total time (mins)			Dosages			
No.	Date	Age/Sex	Induction	Down	Revival	ml Immobilon (mg Etorphine) (mg Acepromazine)	ml Revivon (mg diaprenorphine)	Site of dart	Remarks
1.	13.4.83	Adult M (Machna)	31	42	4	3.25 (8.0) (32.5)	4.0 (12.0)	Left of spine anterior to base of tail	On revival the animal got up quickly and walked towards the riding elephant before moving away.
2.	20.4.83	Adult M (Tusker)	22	44	9	3.0 (7.4) (30.0)	4.0 (12.0)	Right hind limb middle of thigh	Walked briskly away into the jungle after revival.
3.	27.5.83	Adult F	—	max. 78	6	3.0 (7.4) (30.0)	3.5 (10.5)	High on back on right	As animal was darted late in the evening and in very thick jungle it was not observed going down but was located 55 minutes after darting with the help of radio dart signals. It was immobilised, but neck, trunk and ears were mobile. On revival it got up quickly and immediately charged the domestic elephant but on hearing the report of a 12 bore shot gun it ran off.
4.	30.10.83	Adult F	35	max. 30	N.A.	1.75* (4.3) (17.5)	Nil	Low on left thigh	Radio dart dislodged after 500 m; animal only partially down when found and struggling to get up but unable. After 30 mins standing, swaying from side to side and charged vigorously when approached on domestic elephant; after another 30 mins gently swaying from side to side but placid; animal was left to recover without further intervention. *The dart fired contained 3.5 ml Immobilon but on recovery plunger cap was unexploded and 1.75 ml drug remained in dart, hence 3.5-1.75 = 1.75 ml only discharged into animal by impact.

TABLE 1 (contd.)

5.	3.12.83	Adult F	15	60	41	3.50 (8.6) (35.0)	3.5 +2.5 (10.5 +7.5)	Base of tail on right	Eleven minutes after being given the antidote the animal stood up slowly and then sat down again. After another 26 minutes tried to stand and then lay down again. Another 2.5 ml of Revivon was shot in after a further 4 minutes, she stood up immediately, still swaying a little. After another 18 minutes there was increased muscular movement. She attempted to charge the domestic elephant as it walked in front of her. She stood in the same spot for 7 hours, when she moved off and eventually joined her calf and herd.
6.	17.4.84	Adult M (Tusker)	—	max. 324	9	3.0 (7.4) (30.0)	3.0 (9.0)	Left back above base of tail	A radio-dart was used in this case but on impact the battery was dislodged and therefore not emitting signal. Dart subsequently fell off animal prior to going down. The animal was finally located in very thick jungle after 5 hours, 1.5 km from darting place and was too active to put on radio collar. Revivon was shot in intramuscularly in left forelimb. Immediately on getting up after the antidote was given the animal sprayed itself and stood in the same spot for another hour with its ears flapping continuously.

Although induction time is not known, the animal was presumably down for approximately 5 hours (300 minutes). Fortunately it was in lateral recumbancy and appeared to suffer no ill effects from such a long immobilisation. Body temperature was probably elevated, as indicated by the animal cooling itself by spraying gastric fluid on its body and excessive ear flapping following revival.

Doses of Revivon ranged from 3 to 6 ml (9 to 18 mg diprenorphine) and were of either equal or greater volume than the amount of Immobilon given to the animal. In Case No. 5 due to an unusually slow response to the initial intravenous injection of 3.5 ml Revivon a further dose of 2.5 ml was given after 41 minutes by dart into body muscle which brought an immediate response.

What may be regarded as normal revival times (time between injection of Revivon and animal standing up) were achieved in Cases 1,2,3 and 6, showing a range of 4 to 9 minutes. Case No. 5 took an unusually long time to get up permanently, *viz.* 41 minutes after the first (intravenous) dose of Revivon. She also took an extremely long time to regain full mobility, standing in one spot for 7 hours after revival. It is not clear what was responsible for this slow return to normality. The dose of Immobilon (3.5 ml) was the largest in the series but the etorphine should have been quickly antagonised by the equal volume of Revivon. However, the first dose of Revivon given was out-of-date stock and may have had a reduced potency. There was rapid revival after the second (intramuscular) dose of Revivon from fresh stock. However, the long period of ataxia following revival may have resulted from the high dose of acepromazine (35 mg) which has a prolonged tranquillising effect after recovery from the etorphine brought about by the antagonist (Revivon).

The radio-dart proved useful in locating the darted individual in only one case out of three in which it was employed, *viz.* No. 3. In Case No. 4 the charge proved inadequate for the distance, resulting in the radio-dart being lodged low down in the thigh from where it was soon brushed off as the animal moved away through thick vegetation. In Case No. 6, although the dart was satisfactorily sited high on the animal near the base of the tail, it became dislodged after some distance, presumably as the animal passed under a low branch of a tree. In addition, the battery was apparently displaced on impact resulting in the immediate loss of the radio signal. The immobilised animal was only found after a very prolonged visual search in particularly dense jungle.

DISCUSSION

The results reported here indicate that a dosage of 7 to 8 mg etorphine in combination with 30 to 32 mg acepromazine, is effective for the immobilisation of wild adult Indian elephants. This upper limit is in general agreement with adult dosages reported in the literature from other countries (Jainudeen and Khan l.c.; Jainudeen *et al.* l.c.). Lower dosages than 7 mg have been used successfully by several workers but we recommend that not less than 6 mg should be used on adult elephants in order to ensure relatively rapid immobilisation without the necessity of a topping-up dose. Certainly a dose as low as 4 mg runs the risk of a long induction period or incomplete immobilisation as in Case No. 4 reported here.

The induction times in this short series show a similar range (15-35 minutes) and mean (26 minutes) to the eleven cases of Jainudeen and Khan (l.c.) which were 15 to 45 minutes and 24 minutes respectively. Both series serve to indicate that considerable variation in induction times can be expected when immobilising Asiatic elephants with etorphine. There seems little evidence in the literature that the addition of acepromazine reduces induction time in this species. Indeed Jainudeen *et al.* (1971) achieved unusually short induction times (8-19 minutes, mean 13 minutes) using etorphine alone in the immobilisation of four aggressive working elephants. A way of consistently producing a short induction period would be of great assistance in the immobilisation of free-roaming elephants, as much time can be wasted in locating the darted animal if a prolonged induction enables it to move a long way from the darting site before going down.

Apart from Case No. 5, the revival times were similar (range 4-9 minutes) to those reported elsewhere. The unusually long recovery time of 15 hours in the case of the elephant immobilised by Ghosh (l.c.) was probably caused by the unusually high dose of the tranquiliser acepromazine (75 mg) administered, in addition to 10 mg diazepam. It does not appear to have been due to the etorphine, which although given in a high dosage (10.13 mg) appears to have been antagonised by the initial 21 mg diprenorphine, as evidenced by attempted standing after 8 minutes. The prolonged ataxia (7 hours) of Case No. 5 in this report similarly may have resulted from a rather high dose of acepromazine which is not reversed by diprenorphine. Prolonged recumbancy in elephants is dangerous, especially in the sternal position. The 5-hour lateral recumbancy in the present Case No. 6 was unavoidable due to radio-dart failure but such long periods of immobilisation should be avoided if at all possible.

The removal from its shoulder of the dart used to inject Revivon into Case No. 6 illustrates the desirability of avoiding this site when darting elephants. It is difficult to identify a darted animal during the induction period unless the dart remains attached to it.

The three cases in which radio-darts were employed do not appear to offer much encouragement regarding the usefulness of these devices in elephant immobilisation. However, it is a very small series on which to base a definitive judgement. The retention of these heavy darts in the animal may be improved by the use of a needle with a barb, rather than a retention collar as in this series. The disconnection of the transmitter battery on impact indicates the need for a modification of the radio-dart design on the part of the manufacturer. Further trials incorporating these improvements would certainly be worthwhile, as the delayed location of darted elephants in thick jungle can jeopardise the animals' lives.

The 3 or 4 ml aluminium syringe barrels fitted with a standard Distinject NM6 63 mm needle proved satisfactory for injecting Asiatic elephants, providing entry of the needle was more or less at right angles to the skin surface. However, a longer needle (75 to 80 mm) would be preferable, especially in cases where an ideal angle of entry is not achieved. No barrel breakage or distortion, of the type sometimes experienced when plastic syringes are used on thick-skinned species, was experienced.

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DISTRIBUTIONAL RECORDS FOR SOME INDIAN TURTLES[1]

Edward E. Moll[2] and J. Vijaya[3]

A nine month survey of emydid and trionychid turtles in India conducted by the authors in 1982-1983 produced noteworthy distribution records for 10 species: *Cuora amboinensis, Geoclemys hamiltoni, Kachuga tecta, Melanochelys tricarinata, Melanochelys trijuga indopeninsularis, Morenia petersi, Chitra indica, Pelochelys bibroni, Trionyx hurum* and *Trionyx leithii.*

INTRODUCTION

From September 1982 through June 1983 we conducted status surveys of emydid and trionychid turtles in nine Indian states. The primary objective of the project was to investigate the conservation status and needs of these frequently exploited species. Certain of our findings have been reported previously (Groombridge *et al.* 1983, Moll 1985a, 1985b and *in press*). In the course of these surveys we discovered several noteworthy distribution records. These are reported herein.

METHODS

Aquatic habitats were sampled with trammel nets and hoop traps baited with fish or chicken entrails. Fishermen were asked to bring in any turtles incidentally caught in their nets. Local markets and garbage dumps were canvassed for turtles and skeletal remains respectively.

Specimens were measured to the nearest millimeter with vernier calipers in the manner of Carr (1952). Measurements including maximum straight line carapace length (CL), carapace width (CW), plastron length (PL) and shell height (H) are given in millimeters. Weights were taken with a spring scale to the nearest 5g for turtles less than 5 kg and to the nearest 0.5 kg for larger species.

Museum abbreviations include: BNHS — Bombay Natural History Society, EOM — E. O. Moll field numbers, FMNH — Field Museum of Natural History, Chicago, Illinois, ZSI — Zoological Survey of India, Calcutta.

RESULTS AND DISCUSSION

EMYDIDAE

Cuora amboinensis (Daudin)

Material: Juvenile from Mazbat, nr. Maugaldai, Darrang District, Assam; ZSI 16690 — 52 CL, 41 CW, 47 PL, 20 H.

Smith (1931) reported Tenasserim as the western-most limit of the range of this species. More recent finds indicate that India is the western limit of the range.

Biswas and Sanyal (1977) reported a specimen of *Cuora* from the Nicobar Islands. In passing they mentioned another specimen in the Zoological Survey of India collection from Assam. In 1983, we had opportunity to verify the identification of this specimen, ZSI 16690,

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from near Maugaldai which is N of the Brahmaputra River.

The specimen appears to be a juvenile near hatchling size. The head pattern of three yellow stripes is typical for the species. The uppermost stripe runs from the snout above the eye and tympanum onto the neck. A lateral stripe extends from the snout through the eye over the tympanum and onto the neck. The ventral most stripe runs under the eye curving upward to meet the lateral stripe just anterior to the tympanum.

The plastral pattern is also typical with each yellow scute being marked with a dark blotch. However, the carapace pattern of three light stripes on a dark background appears unreported for the species. It comprises a broad mid-sagittal stripe flanked by a pair of thin lateral stripes that extend over a weak, broken, keel along the pleural scutes.

The discovery of *Cuora amboinensis* in Bangladesh (Khan 1982) supports the validity of this locality.

Geoclemys hamiltoni (Gray)

Material: One carapace found in a garbage dump at Bherihari Colony Village, *c.* 10 km S Gandak Dam, West Champaran District, Bihar; BNHS 1316 — 322 CL, 201 CW.

Smith (1931) reported the distribution as Northern India from Sind to Bengal pointing out that precise locality data were rare. The only recent information on the range in India is its discovery in Kaziranga National Park in Assam (Vijaya 1983).

Reputedly taken in a forest pond, the Bihar specimen is the largest recorded for India. Minton (1966) reported a 350 CL specimen from Pakistan. The finding of this turtle so near the Nepal border suggests that the range includes this country as well.

Kachuga tecta (Gray)

Material: Female from Narmada River, Dhavdi Ghat, Nr Punasa, East Nimar District, Madhya Pradesh; EOM 2784 — 183 CL, 142 CW, 172 PL, 89 H, 960 g. Two juvenile specimens from Chandola Lake, nr. Ahmedabad, Ahmedabad District, Gujarat (collected by P. Kannan): BNHS 1290 — 86 CL, 65 CW, 80 PL, 45 H; BNHS 1291 — 85 CL, 68 CW, 81 PL, 45 H.

Smith (1931) defined the range as northern India including the Ganges, Brahmaputra, and Indus River systems but mentioned its exact limits were not clearly defined. The above specimens extend the range from these northern drainages into peninsular India.

Melanochelys tricarinata (Blyth)

Material: Three specimens from a forest near Bherihari Colony Village, *c.* 10 km South Gandak Dam, West Champaran District, Bihar: BNHS 1317, female — 138 CL, 88 CW, 116 PL, 57 H; BNHS 1318 (carapace only) — 143 CL, 94 CW; living male — 155 CL, 100 CW, 134 PL, 67 H, 440 g.

Smith (1931) reported the range of this species as "Chaibassa district, Chota Nagpur (Bihar); Jalpaiguri district, N. Bengal and Daflas and Bisnath Plain, N. Assam. Although Smith regarded the species as a hill species, the present specimens come from flatland forest. These records extend the turtles range in Bihar to the extreme northwestern corner of the state. The close approximation of Uttar Pradesh and Nepal to this site suggests that the turtle occurs in these localities as well. In fact we have seen photos of a tricarinate hill turtle taken in Nepal's Chitawan National Park by Mr. Peter Jackson of the International Union for the Conservation of Nature (IUCN).

Melanochelys trijuga indopenisularis (Annandale)

Material: 26 specimens from Bheriharі Colony Village, 10 km S. Valmiki Nagar (at Nepal Border), West Champaran District, Bihar: EOM 2887 juv. — 123 CL, 89 CW, 113 PL, 51 H, 265 g; EOM 2888 male — 250 CL, 169 CW, 226 PL, 99 H, 1935 g; 24 shells EOM 2842-2862 — 129-326 (x = 237) CL, 99-219 (x = 165) CW.

Smith (1931) reports the range as Chota Nagpur and Jalpaiguri District, N. Bengal. Our records extend the range to extreme northwestern Bihar and suggest the likelihood of its occurrence in adjacent Uttar Pradesh and Nepal.

According to villagers these specimens came from forest ponds and small tributaries of the Gandak River.

Morenia petersi (Anderson)

Material: Three specimens from an oxbow lake and nullah, Udaipur Forest, 15 km W. Bettah, Bihar: FMNH 224146, male im. — 113 CL, 77 CW, 101 PL, 56 H, 235 g; FMNH 224150, male im. — 100 CL, 74 CW, 88 PL, 53 H, 190 g; BNHS 1315, female im. — 128 CL, 92 CW, 116 PL, 67 H, 380 g.

Smith (1931) reported this species only from Jessore District, Dacca and Fategarth in Bengal, areas which are now in Bangladesh. In 1859, Blyth obtained 2 living specimens from the Calcutta markets but their origin was uncertain. Our specimens establish the occurrence of *Morenia* in India and extend the western limits of the range to northwest Bihar. Khan (1982) reported that the turtle is associated with riverine habitats in Bangladesh. These specimens were found in weed choked nullah with little current and in a more open oxbow lake.

TRIONYCHIDAE

Chitra indica (Gray)

Material: One carapace collected from the Godaveri River at Polavaram, East Godaveri District, Andhra Pradesh; EOM 2692 — Length of bony carapace 353. Six carapaces from the confluence of the Mahanadi and Kathugauri Rivers, Nanaj, Cuttack District, Orissa: EOM 2697, 2700 — 2703 and FMNH 224234 — Lengths of bony carapaces, 169-322 (x=210).

This large softshell has long been known from the Indus and Gangetic drainage in India (Smith 1931, Minton 1966). Webb (1981) discovered two specimens collected near Dhond, Maharashtra (190 km ESE Bombay) in the collection of the Zoological Survey of India. Presumably these turtles came from the Krishna River drainage. Our specimen supports the occurrence of the narrowheaded soft shell in peninsular India and adds the Godaveri and Mahanadi Rivers to the range.

Pelochelys bibroni (Owen)

Material: Two carapaces, from the mouth of Subarnarekha River, Udaipur Village, 3 mi. NE Chananeswar, Balasore District, Orissa: FMNH 224233 and EOM 2676 — Lengths of bony carapaces, 318 and 323 respectively. One unnumbered juvenile specimen in the Trivandrum Museum collected in 1909 and labelled Trivandrum, Kerala; — 310 CL, 257 CW, 251 PL, 51 H.

Smith (1931) reported a specimen of *Pelochelys* in the Indian Museum labelled Calcutta but considered the occurrence of this species in India to be doubtful. More recently definite identifications of *Pelochelys* have been made in Indian waters. Nair and Badrudeen (1975) reported on a specimen collected at sea near Point Calimere. Tamil Nadu. C. S.

Karr found *Pelochelys* nesting with olive ridley sea turtles on the Gahirmata nesting beach in Orissa (Vijaya 1982).

The two carapaces from the Subarnarekha River extend the known range in India to the Orissa — West Bengal border. The specimen from Trivandrum indicates that this turtle also inhabits the West Coast of India. Jerdon (1853) mentioned that a specimen identified as *Gymnopus indicus* was collected at Mahe along the Malabar coast. Webb (1981) suggested that due to the marine habitat of this specimen that it might be *Pelochelys* rather than a *Chitra*. The Trivandrum record adds support to this view.

Trionyx hurum Gray

Material: One male collected in the Gandak River, Bherihari Wildlife Sanctuary, West Champaran District, Bihar; BNHS 1313 — 302 CL, 224 CW, 227 PL, 84 H. One immature female from the Gandak River, border between India and Nepal, 5 mi S. Valmiki Nagar, West Champaran District, Bihar; EOM 2863 — 277 CL, 221 CW, 198 PL, 69 H, 2185 g.

Smith (1931) listed the range as lower reaches of the Ganges and Brahmaputra. Forty per cent (14 of 36) of the *Trionyx* that we observed in markets in Northern West Bengal (i.e. around Siliguri and Jalpaiguri) were *T. hurum*. Market vendors reported that most of these came from the northern tributaries of the Ganges. These specimens from the Gandak River confirm the occurrence of peacock softshells in northwestern Bihar, northeastern Uttar Pradesh and Nepal.

Trionyx leithii Gray

Material: Two specimens from pond adjacent to Godaveri River, Kotipalle, East Godaveri District, Andhra Pradesh: FMNH 224235 female im. — 358 CL, 303 CW, 271 PL, 85 H, 4.4 kg; living male presently at Madras Crocodile Bank — 591 CL, 488 CW, 435 PL, 175 H, 26 kg. One living female from Balimela Reservoir, Sileru River, Chitrakonda, Koraput District, Orissa; currently at Nandankanan Biological Park, Cuttack, Orissa — 500 CL, 393 CW, 388 PL, 148 H, 15 kg. Six specimens from Cauvery River drainage:

A. Living female from Moyar River near Palthatti, Nilgiris District, Tamil Nadu, currently at Madras Crocodile Bank — 548 CL, 410 CW, 385 PL, 125 H, 14.5 kg.

B. Two carapaces from the Moyar River, Thivuginamadavu, 25 Km NE Gudalur, Nilgiris District, Tamil Nadu: EOM 2789 and EOM 2790 — lengths of bony carapaces, 240 and 333 respectively.

C. One male and two carapaces from the confluence of the Bhavani and Moyar Rivers, Bhavani Sagar Reservoir, Periyar District, Tamil Nadu: FMNH 224231 — 635 CL, 471 CW, 427 PL, 154 H, 19.5 kg. EOM 2816 and 2817 — lengths of bony carapaces — 364 and 271 respectively.

Smith (1931) gives the range as the Ganges and rivers of peninsular India. On our survey we found no *T. leithii* in the Ganges River drainage. Annandale (1915a) also questioned the validity of records of this species from the Ganges but shortly thereafter he (1915b) reported finding several young specimens in an old collection in the Indian Museum from Allahabad and the River Hughli.

We question these identifications as Annandale's key to the *Trionyx* (1912a) used inadequate characteristics to differentiate between *leithii* and *gangeticus* (particularly juveniles). The key stated that ocelli are present on *leithii* juveniles and absent on *gangeticus*. Ocelli, however, are present on the young of both (see photos of juvenile *gangeticus* in Daniel (1983) and Pritchard (1979). The key also stated that only *gangeticus* possessed a ridge along the inner mandible. We have noted, however, hat this ridge seems to develop with age and is difficult to discern in juveniles. As all of the *T. leithii* records from the Ganges are young specimens it is possible that Annandale simply misidentified young *gangeticus*. Similarly Annandale's (1912b) identification of young *Trionyx leithii* collected by Blanford from the Hasdo, a tributary of the Mahanadi River also requires verification.

The key in Smith (1931) follows that of Annandale (1912a) thus perpetuating identification errors. A better external characteristic for identifying *T. leithii* is a dense patch of flat wart-like tubercles at the mid-anterior edge of the carapace. An additional patch of tubercles usually occurs along the midline just posterior to the bony portion of the shell. We have found this character to be discernible on individuals as small as 80 mm CL. Smaller individuals still need to be examined to determine the reliability of this characteristic in early ontogenetic stages.

Considering the uncertainty of many of the records for this species, these new localities seem worth publishing. The specimens from Kotipalle on the Godaveri River verify Anderson's identifications of the *Trionyx* collected by Blanford (1879) on this river. The specimen from Balimela reservoir confirms the occurrence of the species in Orissa albeit from the Godaveri not the Mahanadi drainage. The Balimela turtle is unusual in coloration being very dark dorsally (almost black) with the plastron (usually white) also being suffused with dark pigment. The specimens from the Moyar and Bhavani Rivers represent the first records of the genus from the Cauvery River drainage.

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SOME OBSERVATIONS ON WILD BOAR (*SUS SCROFA*) AND ITS CONTROL IN SUGARCANE AREAS OF PUNJAB, PAKISTAN[1]

M. M. Shafi and A. R. Khokhar[2]

INTRODUCTION

In Punjab, the wild boar (*Sus scrofa*), lives principally in four types of habitat, (1) riverain 'belas' (*Saccharum spontaneum* and *S. munja* grasses), (2) canal side plantations (*Prosopis juliflora, Dalbergia sissoo* and *Acacia arabica*), (3) forest plantations (*Acacia* sp., *Dalbergia* and *Prosopis juliflora*) and (4) fields of mature sugarcane and other tall agricultural crops which afford sufficient shelter to wild boar.

The distribution of wild boar in Pakistan has been favoured during the past 30 years due to development and spread of irrigation and irrigated forest plantations which provide excellent cover to this animal. The absence of predation pressure due to vanishing of large carnivores — lions and tigers (Roberts 1977) and Muslim abhorrence towards wild pig have also contributed to their spread in Pakistan.

Development of sugar industry in the past has encouraged large scale cultivation of sugarcane crop in the country. This has also led to the proliferation of wild pigs and their damage to sugarcane crops. Mirza (1978) has estimated an annual loss of about Rs. 5,01,22,842.00 sustained to agricultural crops by wild pig in Faisalabad District alone.

Inspite of the past reports on severe infestation of wild pigs and their losses to agricultural crops and forest nurseries in Pakistan, there is no authentic publication on the use of poison baits to check their population. Except for some preliminary information on the biology of wild pig in Pakistan (Taber 1964, Roberts 1977, Smiet *et al.* 1979) there have also been no previous study on the population dynamics of the pest. Inayatullah (1973) has given a good account of wild boar distribution in Pakistan.

Some of the pig control methods tried in the past in Pakistan were shooting, hunting by dogs, use of hog cholera virus, electric fences, announcement of bounties and some use of various insecticides. All these control methods did not bring any substantial reduction in the pig population.

STUDY AREA

Wild boar control trials were conducted in sugarcane fields at Chiniot in Sargodha District (31° 43′N, 72° 59′ E) along the western side of River Chenab and at Manan Wala in Sheikhupura District (31° 47′ N, 74° 15′ E) on either side of Gogera Branch Canal. The main crops grown between the sugarcane fields were wheat (3-4 inch high), potato, sweet potato, peas and other vegetables.

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MATERIALS AND METHODS

Estimation of sugarcane damage:

Damage estimate of sugarcane crop was made in randomly selected 25 hectares plot each of the three mainly grown varieties, i.e. Triton, BL_4 and L_{118}. A transect line bisecting the field was established. After every 5 steps number of both damaged and undamaged canes within approximately a m^2 area along the transect was noted down.

Estimation of pig population:

Crude estimate of pig population living in the dense cover of sugarcane fields were made using the following formula:

$$\frac{M\ N}{O}$$

Where M = Number of wild pigs counted while feeding at the baiting stations at sun down on the last day of pre-treatment feeding.

N = Total area of sugarcane fields which on survey was found to be infested with wild boars.

O = Area of sugarcane fields, selected out of the total infested area, from where wild pigs were drawn out to feed at the baiting stations.

Bait and baiting stations:

Wild boars freely fed on various forms and combinations of cereal bait typically for 5 nights (Table 1). The bait was laid in 5-6 metres long and 25-30 cm deep mud plastered trenches excavated in the open between the sugarcane fields. The idea of laying the bait in rows was to offer equal chances to all pigs irrespective of their age, sex and strength to feed at the baiting stations. This is because the pigs have intraspecific dominance hierarchy (Roberts, pers. comm.) and smaller and weaker males would be afraid to approach near the bait stations (Singer *et al.* 1981) unless it was carefully distributed in rows along shallow channels.

On the 6th night the pigs were fed on poison bait made in water solution of 1080 (*Sodium fluoroacetate*) and 1081 (*Sodium fluoroacetamide*) at 0.03% and 0.035% concentration, respectively. The activity index of the animals was determined on the basis of the bait intake on the last day of pretreatment and post treatment feeding undertaken for one night. The bait take was measured in the early morning and replenished in the evening.

Dead pigs were collected from the sugarcane fields. Some data on age, sex and reproduction were taken before burying them to avoid secondary effect of the poison on non-target wild life.

RESULTS

Pig population in the total sugarcane area of Chiniot and Manan Wala was respectively estimated to be 1063 pigs in 3237 hectares ($32.2/km^2$) and 2037 pigs in 2832 hectares ($72.1/km^2$).

The per cent damage in three varieties of sugarcane was: Triton 35.4%, BL_4 8.3% and L_{118} 6.7%. Triton was found to be more soft and sweet than the other two varieties.

Results of the trials are summarized in Table 1. There is gradual increase in the bait takes, the maximum being on the last day of pre-treatment feeding. The addition of molasses increases the bait intake. The wild boar activity reduced sharply by 100% on all but two baiting stations where it was 83.3% and 80%. Pig

TABLE 1

RESULTS OF THE POISON BAITING TRIALS AGAINST WILD PIG (*Sus scrofa*) IN SUGARCANE FIELDS OF PUNJAB AREAS

Tehsil	Trial site	Bait	Consumption of pre-treatment bait, (kg)					Consumption of post treatment bait, (kg)	% reduction in activity index
			Day 1	Day 2	Day 3	Day 4	Day 5		
Chiniot	Chakbandi	Dry wheat	10	20	25	28	30	0	100%
	Lasla	Dry paddy	10	20	20	25	30	5	83.3%
	Waras Lasla	+ dry wheat Dry maize	5	12	20	30	32	0	100%
	Waras Lasla Waras	+ dry wheat Dry maize + dry wheat + molasses	0	10	15	38	40	0	100%
Manan Wala	Chak 3	Boiled wheat + molasses	6	10	15	40	48	0	100%
	Baga Chak	Wet wheat + molasses	5	10	25	40	50	10	80%
	Wara Gabian	Wet wheat + molasses	1	8	15	50	55	0	100%
	Ittan* Wali	Boiled wheat + molasses	6	25	45	50	—	0	100%

* only place where 1081 was used.

behaviour on these two baiting stations, on query, was found to be disturbed by human presence near the baiting stations.

Out of the 124 dead pigs collected, 53 were males and 71 were females. The age ratio was 47 adults to 77 juveniles separated on the basis of body stripes (Diong 1973, Stegeman 1938). All the juveniles were maned. Most of the young were found lying near the adult females close to their bedding places made of dry grasses. No adult male was found near the juveniles or the adult females Altogether, the number of adult females in the collection was significantly higher than the adult males ($x^2 = 9.4$; $P < 0.01$, 1 df, Sokal and Rohlf 1969). In the juveniles, 40 were males and 37 were females indicating a nearly even sex ratio (Table 2).

TABLE 2

SEX RATIO OF ADULT AND JUVENILE WILD BOAR COLLECTED FROM THE SUGARCANE FIELDS OF PUNJAB

Place	Adult		Juvenile		Total
	Male	Female	Male	Female	
Chiniot	5	13[a]	26[b]	24	68
Manan Wala	8	21	14	13	56
Total:	13	34	40	37	124

a.b. Each with one black individual.

DISCUSSION

Inayatullah (1973) and Smiet *et al.* (1979) respectively estimated 27 pigs per sq. mile (10.4/km^2) in Changa Manga forest, Punjab and 9.6 pigs per sq. mile (3.7/km^2) in forest tracks of Thatta in southern Sind. Our estimates in sugarcane area are very high compared with the above estimates. These apparently high population estimates could be attributed to large scale immigration of wild pig from perpetual cover of forest, riverine 'belas' and canal side plantations into thick cover of sugarcane crop. The collection of all the dead pigs from within the sugarcane fields and presence of most of the adult females with juveniles just on or near the elaborate bedding places suggest that they had lived in sugarcane fields for quite some time before our poison baiting trials. Obviously, the sugarcane crops provide shelter to these animals only up to their harvest after which they seem to migrate again to their perpetual covers.

The wild pigs not only use sugarcane crop as protective cover but also cause heavy damage to it. Our damage estimate work showed that more soft and sweet varieties of sugarcane are comparatively much more vulnerable to pig attack.

The gradual increase in the consumption of plain grain suggests that the pigs are slowly assembling at the baiting stations, the maximum number being on the last day. The results of these trials indicate that 1080 (*Sodium fluoroacetate* (0.03%) with cereal grains and molasses, if used under strict supervision following pre-treatment feeding, can safely cause a sharp reduction in the wild pig populations living in undisturbed and restricted areas.

Significantly less number of adult males than adult females in the collection shows that the probably move greater distances and have larger seasonal home ranges than females (Singer *et al.* 1981).

62% of the total collection comprised of stripped and maned juveniles. The mane appears when the pig reaches the age of 1-2 months (Stegeman 1938). The stripes disappear when the young are 5 months old (Diong 1973). The presence of mane and stripes on the young therefore suggests that they were not less than 1-2 months and more than 5 months in age. Taking into account the collection month (December) of the juveniles and their possible range of age, they appeared to have been born some time between July and October-November. This is supported by Roberts (1977) who reported that most of the litters of wild pig in Pakistan are born between July and October when the vegetational cover is at its maximum due to monsoon. Even in India majority of reproduction of wild pig takes place shortly before and after the rains (Prater 1971).

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OBSERVATIONS AND COMMENTS ON BIRD CASUALTIES AT MALSHEJ GHAT HOLIDAY CAMP, MAHARASHTRA[1]

SUNJOY MONGA[2] AND ULHAS RANE[3]

(*With two text-figures*)

The MTDC resthouse at Malshej Ghat is situated at Ghatmatha (top of the ghats), above a deep funnel shaped valley towards the west, at an altitude of about 750 m. It is located in Murbad taluka of Thane district. Lying on the Deccan plateau of the Sahyadri mountain range, the Ahmednagar and Pune districts are adjacent to it, also on the plateau the ghat region and the valley are well clothed with moist deciduous forests. The enormous plateau, however, is fairly barren with patches of scrub forest. Harishchandragadh fort (alt. 1450 m) is located to the north of this plateau, rising about 700 m higher than the plateau.

A BNHS nature-camp was organised to this area on 23-24 June, 1984. The SW monsoon had only recently set and while driving through the ghat on 23rd June morning, we could see that a thick mist enveloped the top of the ghat. By about 10.00 hrs when we reached the top, the mist had suddenly cleared and there was sun light. There was an extremely strong westerly wind, blowing at a velocity which we estimated to be about 80 km/hr. The average temperature was 25°C and relative humidity about 70-80%. When we went to the edge of the plateau to have a look at the deep valley, we realised that not only did these strong winds make walking difficult, but also observing through binoculars was not easy.

The resthouse staff informed that such strong winds are characteristic of this area at this time of the year. It is the massive wall of the Harishchandragadh mountain in the north which is the major barrier to the SW winds. These winds thus get chanelled at an incredible velocity through the forested valley and are driven upwards, chilly and biting towards the plateau.

Less than ten minutes after having reached here, a Little Brown Dove (*Streptopelia senegalensis*) was caught, its forehead badly injured. Within a few minutes of this, a dead bird of the same species was located. Its forehead was injured too and the neck was broken. Within another half hour we spotted a Chestnut Bittern (*Ixobrychus cinnamomeus*), crouching on the rocks. On picking it up we found that its left leg was broken and hanging loose.

A short while later we were standing over the funnel where the winds gushed at their fastest. We observed a Whitebacked Vulture (*Gyps bengalensis*) taking-off from the cliff-edge on our approach. So strong was the wind that the bird could not properly orient itself and almost turned turtle as it rose. On reaching a good height it regained some control and

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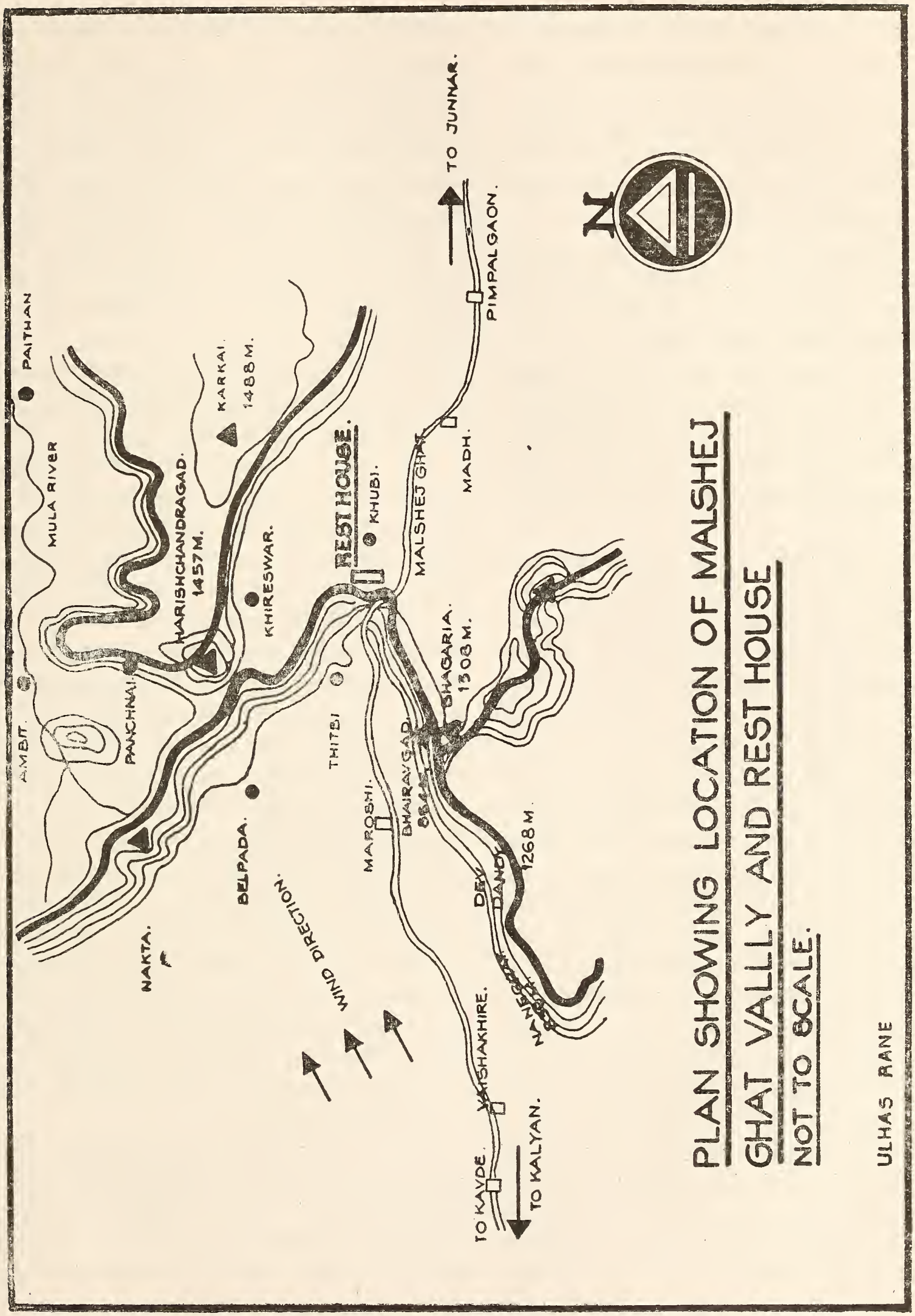
PAITHAN
MULA RIVER
AMBIT
PANCHNAI
HARISHCHANDRAGAD 1457 M.
KARKAI 1488 M.
KHIRESWAR
REST HOUSE
KHUBI
MALSHEJ GHAT
MADH
PIMPALGAON
TO JUNNAR
N
BELPADA
THITBI
NAKTA
WIND DIRECTION
MAROSHI
BHAIRAVGAD
SHAGARIA 1308 M.
DEV DAND
1268 M.
VAISHAKHIRE
TO KAVDE
TO KALYAN
PLAN SHOWING LOCATION OF MALSHEJ GHAT VALLLY AND REST HOUSE
NOT TO SCALE.
ULHAS RANE

Fig. 1.

was carried by the wind in a north-easterly direction, towards Harishchandragadh. Some time later, it was seen soaring along with another vulture. Flocks of Cattle Egret (*Bubulcus ibis*) also could not control themselves well in flight, being carried sideways by the strong wind for considerable distances.

The happenings in our first hour-and-half around the resthouse at Malshej ghat greatly aroused our curiosity and we decided to carefully look around the entire area.

By 1900 hrs that evening we had located twenty-two more dead birds of nine species, in addition to above-mentioned Little Brown Dove and Chestnut Bittern. Some of these were found at a considerable distance from the resthouse.

The area continued to be lashed by very strong winds, such as we had been experiencing throughout the day. A thick mist now rapidly covered the entire area and by 1945 hrs visibility had been reduced to just a few metres. The weather and the visibility continued to deteriorate. We had all given up hopes of a good night drive when at 2055 hrs a male Rain Quail (*Coturnix coromandelica*) was seen banging on the big glass window to the left of the main entrance on the eastern face of the resthouse. The bird would flutter up along the glasspane hitting frantically with its beak and forehead. Soon it was exhausted and in our hands. A few minutes later a Yellowlegged Button Quail (*Turnix tanki*) female was caught while hitting the same window and at 2115 hrs a Green Pigeon (*Treron phoenicoptera*) was caught on the same side. By 2145 hrs we had hold of nine birds. Eight of these were caught on the eastern face of the resthouse and one on the western side. One of the Little Brown Doves was actually caught when it hit the porch-light on the ceiling on the eastern side.

Two females of the Yellowlegged Button Quail and the male of the Rain Quail died within an hour of being caught. Of the remaining six live birds, we put colour rings on two Little Brown Doves, a Green Pigeon and a Button Quail male. These birds were then released at about 2240 hrs, almost 200 m south of the resthouse. We took this step primarily to find out if the birds would orient themselves back to the resthouse in the thick mist and so late at night.

At 2250 hrs we went for what turned out to be an unsuccessful drive in the jeep, the powerful searchlights specially fitted on the top hardly able to penetrate the dense mist. On returning we got hold of all available torches and went for another walk around the resthouse. On the western side we flushed two quail (spp?) and one egret-like bird at 2335 hrs. At this juncture we decided to settle in for the night rather than have some more dead birds due to our flushing them. Some other members flushed several other birds around the resthouse. A lot of birds certainly appeared to roost in the immediate vicinity of the resthouse, and all flushed birds flew in the direction of the lights and the resthouse which could however be seen only very faintly.

The whole of the night of 23rd June continued to be thickly mist-laden and it was no different the next morning at 0610hrs, except for the accompanying light drizzle. By 0800hrs that morning we had further located nine dead birds and these included a Common Quail (*Coturnix coturnix*) and a Drongo Cuckoo (*Surniculus lugubris*).

For the next few hours the mist did not clear and there was intermittent rain. We located several severed heads of Watercock (*Gallicrex cinerea*) and also two dead Fruit Bats (*Pteropus* spp?), one of which had a severe head injury. By 1130 hrs the mist was lifting and a very strong wind had once again commenced. Another search in the neighbourhood of the resthouse resulted in six more dead birds. Three of these were found in small cisterns nearby, all on the eastern side.

This brought our overall tally of dead birds found during the past twentyfour hours to thirty-nine. Of the nine we had caught late in the evening of 23rd June, three had died and another Chestnut Bittern was seen (UR & others) smashing on to the rocks and getting killed, thus bringing the total death-count to forty-three. Fourteen species of birds were encountered (See notes on birds).

On the afternoon of 24th June we flushed some Yellowlegged Button Quail west and NW of the resthouse. On flying with the wind (towards east) the birds could not control themselves and one of them actually banged head-on into the wall of the resthouse while another almost did so. The bird which banged into the wall on dropping to the ground looked somewhat dazed, but as one of us approached to catch it, it flew off haphazardly, almost smashing into another wall on the way.

We may also mention here that Dr. Meena Haribal and some other BNHS members who visited this area between 1900 hrs on 7th July and 0800 hrs the next morning encountered over thirty birds of fifteen species within and around the resthouse premises. Dr. Haribal felt convinced that these birds most of which were alive and in a badly battered and exhausted condition, had come into the resthouse for refuge from the bad weather. Almost all of these birds were perched in the vicinity of lights in the verandah, porch and outside the resthouse. Besides the fourteen species we found, five additional species of birds were also seen (MH). Include in bird notes, following comments.

One of us (UR) visited this place again on 9th July from 1030-1530 hrs. Though monsoon conditions prevailed, the wind was not very strong. One Little brown dove and two Whitebreasted waterhens were found dead. Inquiries with the resthouse manager revealed that large number of deaths occured during the first week of monsoon only and the staff also informed that this phenomenon has been observed only since the beginning of this monsoon. Though the number of casualties had considerably reduced after the first week, many birds continued to come into and around the newly-constructed building for shelter from the harsh weather late in the evening. Twenty five quails (of several species) and seven Whitebreasted waterhens (all alive) were reportedly caught within the building premises and sent to Pune in the first week of July. Many sheltering birds are also kept as pets or sold to villagers.

COMMENTS

At this time of the year, when the SW monsoon settles in, Malshej Ghat and the surrounding plateau experiences weather characterised by very high velocity winds and heavy mist and fog (locals pers. comm.).

We found that strong winds take a appreciable toll of birds. The fact that we saw Whitebacked vultures and Cattle egrets unable to fly easily in such weather clearly explains that even strong fliers cannot maintain control while flying in such conditions. Most of the bird species which we encountered and which formed a majority on the casualty-list, are weak-fliers and it is therefore understandable that these are much more susceptible to strong winds.

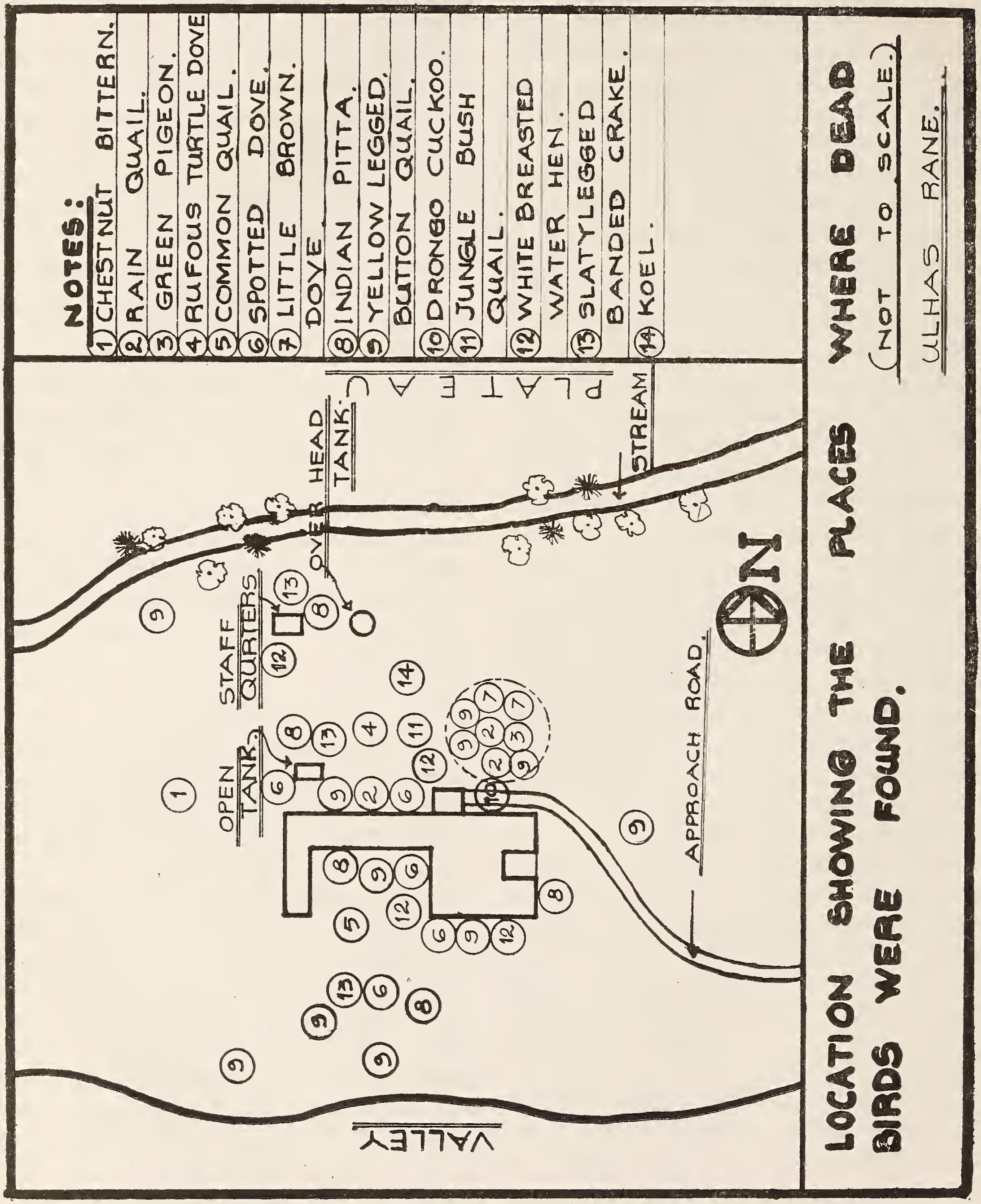
NOTES:
① CHESTNUT BITTERN.
② RAIN QUAIL.
③ GREEN PIGEON.
④ RUFOUS TURTLE DOVE
⑤ COMMON QUAIL.
⑥ SPOTTED DOVE.
⑦ LITTLE BROWN. DOVE
⑧ INDIAN PITTA.
⑨ YELLOW LEGGED. BUTTON QUAIL.
⑩ DRONGO CUCKOO.
⑪ JUNGLE BUSH QUAIL.
⑫ WHITE BREASTED WATER HEN.
⑬ SLATYLEGGED BANDED CRAKE.
⑭ KOEL.
PLATEAU
STREAM
OVER HEAD TANK
STAFF QURTERS
OPEN TANK
APPROACH ROAD.
VALLEY
N
LOCATION SHOWING THE PLACES WHERE DEAD BIRDS WERE FOUND.
(NOT TO SCALE.)
ULHAS RANE.

Fig. 2.

We feel safe to hazard a guess that most birds did not appear to die at first impact. Infact, as we observed during late-evening, the birds bang continuously, fluttering along the windows, hitting their beak and forehead frantically on the glass. Once exhausted, and probably also badly injured, they remain crouched within or around the building and meet their end. During the night of 7th July, Dr. Haribal and others saw in their torchlights, over thirty exhausted and injured and battered birds within the building premises.

While we did find dead birds all around the resthouse during the day (and it is highly probable that many of these were injured during night), eight of the birds were caught during the night (2055-2145 hrs on 23rd June) on the eastern face of the building (these appeared to have come in from the direction opposite to that of the wind flow). But it is important to note here that there was hardly any wind during this period of the evening which however, was characterised by very thick mist, visibility being reduced to hardly four metres.

Very bad weather appears to be highly damaging to birds and it seems that most birds come towards the resthouse as a refuge from the adverse weather. On particularly misty nights the number of birds coming in seems to be high, and there is no doubt that such bad weather is one of the most important factors in this phenomenon. But it is all the more suprising that 'if on thickly mist-clogged nights the birds come into the building and around it for refuge', then how do they spot the resthouse building or the lights in the very thick mist where we checked that visibility to normal human eye was hardly a few metres ? On such nights, do many more birds crash into the building walls and lights more by accident, thereby resulting in higher casualties on such nights? Moreover, while birdwatching in the forest and on the plateau we came across only three of the nineteen species of birds that had had accidents here.

This resthouse is the only lighted spot for a considerable distance around here. According to the staff, the birds are attracted by insects which prefer to remain around the various lights during late evening and nights. Thus coming for the insects, the birds smash themselves on the fixed glass windows through which they actually see the insects flying around the lights. But we found this a highly unconvincing explanation. Most of the (almost all) birds we found are strictly diurnal which at this time of the evening/night should be roosting. So how are these birds attracted by insects at the lights? The only crepuscular bird, Chestnut Bittern (*I. cinnamomeus*) was seen smashed to the ground in broad daylight. A nightjar (*Caprimulgus* spp?), badly exhausted and tattered was seen on 7th July night (MH). It was also observed that most of these birds are not insectivorous and this further rules out the possibility of their being attracted by insects at lights.

It seems highly probable that the bad weather conditions (heavy mist, strong winds and cold) and the new light sources would together be responsible for this phenomenon. If the birds are attracted solely by the lights and hence they bang themselves to death on the building walls (as reported for Lunglei by K. R. Rao and R. Zoramthanga (1976, *JBNHS* 75(3): 927-28), then casualties should have been reported by the staff before the monsoon's outbreak. The staff of the resthouse convinced us that birds came only after the SW monsoon had set in. But most of the birds caught on 23rd June night were at windows through which the lighted interior was visible and one of the Little Brown Doves was actually caught after it had hit the ceiling light in the porch. Also, most of the exhausted and injured birds seen during the night of 7th July were in the vicinity of lights (MH).

It would be interesting to ascertain if having curtains on these windows would in any way result in a reduction in the number of casualties.

A majority of the birds caught during the night (23rd June) were on the eastern/Southeastern side of the building. A good number of exhausted and injured birds were seen in the vicinity of lights on this side on 7th July night (MH). From this one can infer that most of these birds had come from the surrounding forests and plateau on the east and southeast. Birds may have also come from the area between the resthouse building and the valley, but it is doubtful if some had come from the valley itself. For not only is the valley too deep but also the wall face of the valley is very steep and if at all birds are lifted by the strong winds most of these would bang on the valley walls and are unlikely to be lifted almost a thousand feet up, to the plateau. Moreover, the valley did not appear to have the misty and overcast weather conditions of the plateau. It was also observed that most of the birds we caught or found dead prefer a habitat typical of the plateau on the east and some were undoubtedly from the forest which is well represented on the southeast, and also in the valley.

K. R. Rao and R. Zoramthanga, writing on "The phenomenon of nocturnal flights of some resident birds at Lunglei, Mizoram, NE India" (1972, *JBNHS* 75(3): 927-28) report more or less similar observations on bird casualties (occurring annually) by dashing to death against the walls of a building. They report that,

a) Birds dash against the building in late September and early October when the area receives late monsoon rains,
b) the phenomenon occurs when the sky remains overcast without clouds — i.e., without moonlight and with fog and mist. A little drizzle appears favourable,
c) the birds usually fly from west to east, during 7-10 p.m.

They further write "the building, at 1210 m amidst rugged mountain ridges has three prominent lights on the same plane in front of the building and being of high intensity, the lights are seen at night even from far-off distances. The birds are attracted by the lights and dash themselves headlong against roofs and walls and thus get killed."

Our observations are more or less similar to those of Rao & Zoramthanga (1976) and Sálim Ali (1962, The BNHS/WHO Bird Migration Study Project, *JBNHS* 59(1): 128-130), except that these were in late September-early October and Sálim Ali (1962) reports for Haflong that the birds came in from the north.

Some of our observations and findings bear striking resemblance to those of Rao & Zoramthanga (1976) and Sálim Ali (1962).

i) *Almost all species are resident birds*: Same holds true for the Malshej Ghat phenomenon also. Almost all species that we and the subsequent party encountered in the accidents are resident, except perhaps Drongo Cuckoo (*Surniculus lugubris*), Common Quail (*C. coturnix*), Rain Quail (*C. coromandelica*) and Indian Pitta (*Pitta brachyura*). These birds are either considered migrant, passage or breeding for Maharashtra state (Humayun Abdulali — Checklist of Birds of Maharashtra, 1981).

ii) *Green Pigeons* (*Treron* spp.) *attracted to the light in considerable numbers*: We encountered *T. phoenicoptera* banging on the door during late evening on 23rd June. The resthouse staff informed us that they had come across this bird on several earlier occasions in the season, while Dr. Haribal also came across an exhausted and injured bird of this species on the night of 7th July.

iii) *Almost all species are diurnal* (Sálim Ali, 1962)
Except for the Chestnut Bittern (crepuscular) and a Nightjar (*Caprimulgus* spp?) all other species encountered are strictly diurnal.

Very few birds were observed when actually birdwatching on the scrub-covered plateau stretching on the east and northeast. It is noticeable that very few of these were among those found dead or caught during the night.

The birds we saw were:

Cattle egret (*Bubulcus ibis*), in flocks
Common Bee-eaters (*Merops orientalis*), in small parties. Juveniles birds also seen.
Greyheaded Mynas (*Sturnus malabaricus*), in small parties
Brahminy Mynas (*Sturnus pagodarum*), in small parties
Whitebreasted Waterhen (*Amaurornis phoenicurus*)
Jungle Babbler (*Turdoides striatus somervillei*), two small parties, noisy
Redvented Bulbul (*Pycnonotus cafer*), only twice seen
Pond Heron (*Ardeola grayii*), two birds seen
Whitenecked Stork (*Ciconia episcopus*)
Little Egret (*Egretta garzetta*)
Lark (spp?), Whitebacked Munia (*Lonchura striata*), a pair.

In the forested hill towards the south and southeast we observed the following birds:

Whistling Thrush (*Myiophonus horsfieldii*)
Iora (*Aegithina tiphia*)
Spotted Babbler (*Pellorneum ruficeps*)
Redwhiskered Bulbul (*Pycnonotus jocosus*)
Kestrel (*Falco tinnunculus*)
Red Spurfowl (*Galloperdix spadicea*), heard only
Alpine Swift (*Apus melba*), Purplerumped Sunbird (*Nectarinia zeylonica*)
Whitethroated Ground Thrush (*Zoothera citrina*), Blackwinged Kite (*Elanus caeruleus*), Indian Robin (*Saxicoloides fulicata*), Pied Bushchat (*S. caprata burmanica*)

Following are notes on birds which we found dead or caught during the night. Also included are Meena Haribal's observations.

1. YELLOWLEGGED BUTTON QUAILS
(Turnix tanki)

Maximum number of birds found dead and/or caught were of this species. When flushed during the day, these birds on flying towards east (in wind direction) crashed head-on into resthouse wall. Females commoner than males. Five of this species found injured on 7th July night around the building (MH).

2. JUNGLE BUSH QUAIL
(Perdicula asiatica)

One dead male found on 23rd June afternoon. One dead and four exhausted birds of this species within and around the building on 7th July night (MH). No sighting of any during the day.

3. COMMON QUAIL
(Coturnix coturnix)

One dead male found on 24th June morning. This bird is considered a winter migrant to

Maharashtra state (Humayun Abdulali, Checklist of the Birds of Maharashtra, 1981) and the present finding of a male at this time of the year happens to be the only record of this bird for the month of June. By about mid-March most birds are supposed to have departed.

4. RAIN OF BLACKBREASTED QUAIL
(Coturnix coromandelica)

One male was caught at 2055 hrs on 23rd June. The next morning we found two dead females, evidently having died sometime during the night. The male died within an hour of being caught. Later in the BNHS it was found to have enlarged testis, thus indicating that it was in breeding condition. This happens to be the only record of a male *C. coromandelica* in breeding condition found in the neighbourhood of Bombay. The bird is considered a migrant by Humayun Abdulali (Checklist 1981). The two females are also in the BNHS collection presently.

5. RUFOUS TURTLE DOVE
(Streptopelia orientalis)

One was found dead on 23rd June.

6. SPOTTED DOVE
(S. chinensis)

Five dead birds found. Several of these birds, in a exhausted and battered condition were seen in the resthouse premises during the night of 7th July (MH). Not one bird was seen while birdwatching either on the plateau or in forest.

7. LITTLE BROWN DOVE
(S. senegalensis)

Two found dead and two were caught on the evening of 23rd June. None seen while birdwatching on the plateau or in the forest, and none were seen on 7-8 July (MH) either. One of these birds was caught on 23rd evening after it actually hit a ceiling light in the porch. One dead seen on 9th July (UR).

8. RED-TURTLE DOVE
(S. tranquebarica)

Two seen within resthouse premises on 7th July night (MH). One of these was badly injured and was caught.

9. GREEN PIGEON
(Treron phoenicoptera)

One was caught on 23rd June. According to resthouse staff they came across this pigeon on several occasions during this monsoon. One exhausted and injured bird of this species seen during night of 7th July (MH). Green pigeons (*Treron* spp.) have been reported by Rao & Zoramthanga (1976) and Salim Ali (1962).

10. INDIAN PITTA
(Pitta brachyura)

Six dead located in immediate vicinity of building, on 23rd and 24th June. During the night of 7th July, five injured and exhausted birds were seen sheltering in and around the building (MH). *P. brachyura* is considered a passage migrant.

11. WHITEBREASTED WATERHEN
(Amaurornis phoenicurus)

We located four dead waterhens on 23rd and 24th June. Several seen around water-covered localities on the plateau. One found dead near kitchen on 7th July night (MH). Two dead seen on 9th July (UR). Seven of these birds were reportedly caught and taken to Pune in the first week of July (Resthouse staff pers. comm.).

12. SLATYLEGGED BANDED CRAKE
(Rallina eurizonoides)

On 23-24 June four dead birds were located around the resthouse. One of these was in a cistern. A male that was taken to the BNHS had enlarged testis. None seen or heard while birdwatching on the plateau or in forest.

13. WATERCOCK
(Gallicrex cinerea)

One dead female located. Several severed heads of this bird were also located.

14. KOEL
(Eudynamys scolopacea)

One dead male found near building on 23rd June. A dead female was found on 7th July (MH). We never saw or heard any koel.

15. DRONGO CUCKOO
(Surniculus lugubris)

One dead bird found on the morning of 24th June. The bird had undoubtedly died the previous night and was found below a light on the eastern side of the resthouse. None seen or heard. Neither did we see or hear any Drongo spp. An exhausted and injured *S. lugubris* (drongo-cuckoo) was seen on the night of 7th July (MH). This particular bird was a juvenile according to Dr. Haribal.

16. COMMON HAWK CUCKOO
(Cuculus varius)

One actually came and hit the torch Mr. Amonkar was holding at around 2230 hrs on 7th July, while looking out for birds that night. According to him, the bird was sitting on the building roof and appeared to have been attracted by the sudden flash of the torchlight.

17. NIGHTJAR
(Caprimulgus spp?)

One injured and tattered bird seen within resthouse premises late on the night of 7th July (MH). Though there is habitat suitable for nightjars, we did not come across any.

18. THREETOED FOREST KINGFISHER
(Ceyx erithacus)

One bird was spotted late in the evening on 7th July sitting on the toilet window (MH). This bird later flew into the toilet and was caught. This species is presumed to be a breeding migrant to this area, coming at the onset of the monsoon and remaining here to breed.

19. POND HERON
(Ardeola grayii)

One seen immediately outside the resthouse on the night of 7th July (MH). Several seen when birdwatching on the plateau on 23rd and 24th June.

20. SNIPE
(Capella spp?)

A snipe was seen at a puddle behind the kitchen on the night of 7th July (MH). All *Capella* species are winter migrants to peninsular India and as such this happens to be a unusual sighting of a snipe.

Some of the birds that we encountered were collected and taken to the BNHS.

We recommend that this unusual phenomenon be further investigated and checked into, both during and after the monsoon.

ACKNOWLEDGEMENTS

We are grateful to all the BNHS members who participated in this camp. Thanks are also to Dr. Meena Haribal and Mr. Bibhas Amonkar for making us available their observations.

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TAXONOMIC REVISION OF THE GENUS *GAGEA* SALISB. (LILIACEAE) IN INDIA AND ADJOINING REGIONS[1]

Syamali Dasgupta and D. B. Deb[2]

(*With four text-figures*)

Taxonomic revision of the genus *Gagea* Salisb. (Liliaceae) in India and adjoining regions comprising 12 species and 1 extra-typical variety including 1 new species is presented in this paper.

5 species hitherto known as distinct have been reduced to synonymy and 1 to a variety. 5 species are reported for the first time for this region.

Taxa are described with synonyms, original citations, and types. Key to the species is given. Distribution and phenology of the taxa are traced. Exsiccata studied are cited.

INTRODUCTION

Salisbury (1806) separated 7 species so long placed in the genus *Ornithogalum* by Linnaeus (1753, 1754), Pallas (1773, 1776), Schmidt (1794), Willdenow (1799), for their "distinction in habit and fructification". He named the new genus *Gagea* after Sir Thomas Gage who was indefatigable in collecting rare European plants and was liberal in distributing them. This genus differs from *Allium* and allied genera in the absence of involucre of bracts.

Reichenbach (1828) did not accept this generic status but retained it as subgenus under *Ornithogalum* in the tribe *Scilleae.* Schultes (1829) accepted the generic distinction and placed the genus near *Ornithogalum* in the tribe *Asphodelae.* Link (1829) proposed the generic name *Ornithoxanthum* for some of the species placed by Salisbury in his *Gagea.* Lindley (1836) merged *Ornithoxanthum* Link with *Gagea.* Lindley (l.c.), Kunth (1843), Bentham (1883), Boissier (1882) and Hutchinson (1973) placed the genus under the tribe *Tulipeae* whereas Endlicher (1836) placed it under suborder *Tulipaceae* near the genera *Tulipa* and *Lloydia* for basifixed laterally dehiscing anthers. Baker (1874) removed the genus from the tribe *Tulipeae* for the absence of leaf on the scape and umbel inflorescence but did not deal with it subsequently. For the same reason Engler (1888), Krause (1930) and Grossheim (1935) placed it near *Allium* in the subfamily *Allioideae.* In the meantime, some new genera namely *Hornungia* Bernhardi (1840), *Bubillaria* Zuccarini (1843), *Plectostigma* Turczaninow (1844), *Solenarium* Dulac (1867) allied to *Gagea* were described separating some species from the existing genera or for accommodating newly described species. These genera have later been merged with the genus *Gagea* by subsequent workers like Engler (l.c.) and Krause (l.c.).

Salisbury (1806) while publishing the genus *Gagea* did not indicate the type species. Of 7 species he considered for this genus two

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[1] Accepted November 1983.

[2] Botanical Survey of India, Howrah.

were described by Linnaeus (1753) of which *G. minima* (L.) Ker-Gawl. is more representative of the generic description particularly in "Flores corymbosis. Pedunculus ... plus minus decompositus..." and is therefore selected as the lectotype of the genus.

This revision is based on study of specimens extant in CAL, BSIS, BSD, DD, LWG, K, BM, L, G.

Gagea Salisb. in Konig & Sims, Ann. Bot. 2: 555. 1806; Kunth, Enum. Pl. 4: 233. 1843; Benth. in Benth. & Hook. f. Gen. Pl. 3: 819. 1883; Boiss. Fl. Or. 5: 203. 1882; Engl. in Engl. & Prantl, Nat. Pflanzenfam. Teil. 2. Abt. 5: 60. 1888; Hook. f. Fl. Brit. Ind. 6: 355. 1892; Collett, Fl. Simlens. 529. 1902; Krause in Engl. & Prantl, Nat. Pflanzenfam. ed. 2. 15a: 318. 1930; Grossh. in Komarov, Fl. U.S.S.R. 4: 61. 1935; Hutchins. Fam. Fl. Pl. 754. 1973. *Ornithoxanthum* Link, Handb. 1: 161. 1829. *Hornungia* Bernh. Flora 23: 392. 1840 (Type: *H. circinata* Bernh.). *Bubillaria* Zucc. in Pl. Hort. Bot. Moench. 3: 229. t. 2. 1843 (Type: *B. gageoides* Zucc.). *Plectostigma* Turcz. in Trautv. Pl. Imag. Fl. Ross. 9. t. 2. 1844 (Type: *P. pauciflorum* Turcz.). *Boissiera* Haenseler ex Willkomm & Lange, Prodr. Fl. Hisp. 1: 218. 1861. *Solenarium* Dulac., Fl. Hautes Pyr. 117. 1867.

Lecto type: *Gagea minima* (L.) Ker.-Gawl. (*Linn* 428.3 LINN).

Herbs gregarious, 5-22 mm long, bulbous; bulbs small, ovoid, formed of single fleshy radical leaf base and 1 or 2 concentric reduced previous radical leaf bases, outer scales scarious or fibrous; bulbels 1, 2 or numerous. *Radical leaf* 1 or 2, about as long as the inflorescence, lanceolate, linear or terete. *Stem* terete, glabrous, leafy at the base of the inflorescence or all over. *Cauline leaves* 1 to many, lanceolate or linear, passing to bracts above, often with 1 to many bulbils at the axils. *Inflorescence* terminal, corymbose or scorpioid cyme or umbel, sometimes flowers solitary. *Flowers* 5-15 mm long, campanulate; pedicel varies in length; bracts small, linear, at the base of the pedicels or branching of the peduncle. *Perianth* biseriate, yellow inside, glossy, rarely whitish outside with a broad green band, sometimes reddish or dark purple, persistent to fruit, more or less induresent and accrescent, lanceolate or oblanceolate, acute or obtuse; veins parallel, diverging. *Stamens* 4-9 mm long; filaments linear or subulate, attached at the base of the perianth; anthers globose or oblong, basifixed, latrorse. *Pistil* 4-11 mm long; ovary sessile or stipitate, obovoid to oblong, trilobed; style as long as or longer than ovary, triquetrous; stigma truncate, trilobed. *Capsules* 4-8 x 3-6 mm, broadly obovoid, trilocular, trilobed with persistent perianth. *Seeds* many, deep brown, 1.3 x 1-1.5 mm, triquetrous or semirotund, compressed or not, wingless.

Distribution: 70 species are distributed in temperate Eurasia (Airy Shaw 1973). 12 species and 1 extratypical variety are distri- Afghanistan and Pakistan in the west through Kashmir, Nepal to Sikkim in the east (Fig. 1).

RANGE OF VARIATION

1 or 2 bulbels develop at the axil of the buted in Indian subcontinent extending from radical leaf as in *G. anisanthos, G. toppinii, G. reticulata.* In some cases large number of bulbels are produced inside the mother bulb, such as *G. lutea, G. improvisa, G. persica.* Radical leaf is generally solitary, in some species as in *G. anisanthos, G. toppinii,* there are two radical leaves by the germination of one bulbel. Radical leaves vary from linear to

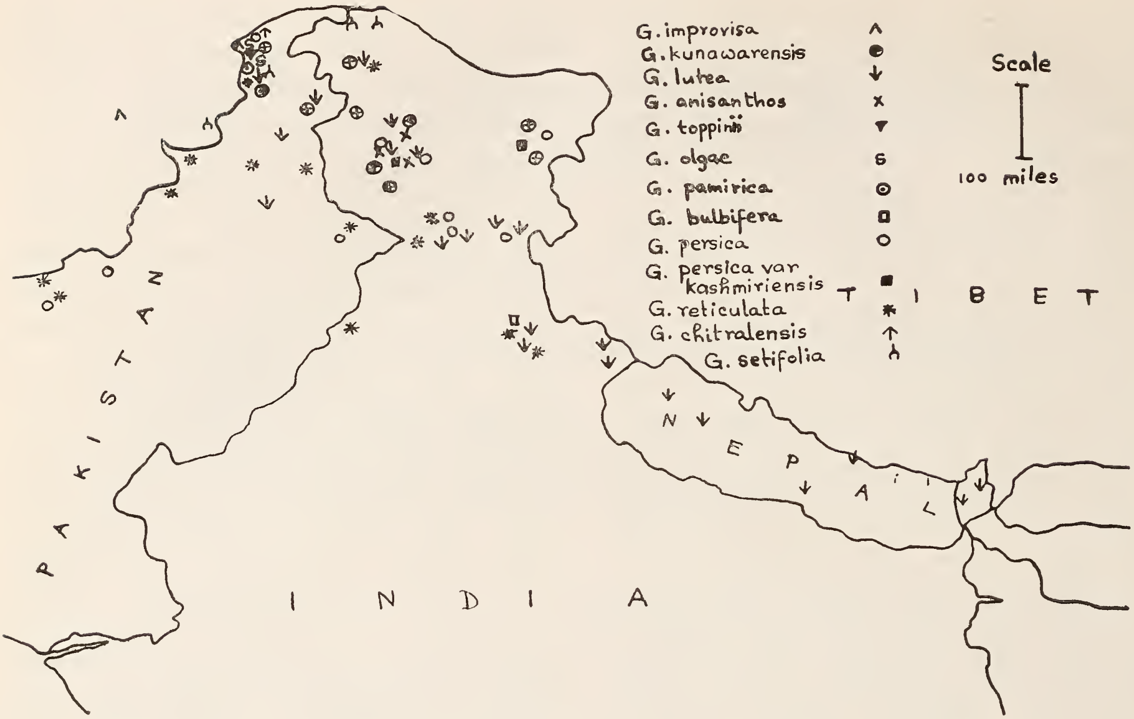
G. improvisa
G. kunawarensis
G. lutea
G. anisanthos
G. toppinii
G. olgae
G. pamirica
G. bulbifera
G. persica
G. persica var kashmiriensis
G. reticulata
G. chitralensis
G. setifolia
Scale
100 miles
TIBET
NEPAL
INDIA
PAKISTAN

Fig. 1. Map showing distribution of *Gagea* Salisb. in India and adjoining region.

lanceolate or broadly lanceolate. It is linear in *G. improvisa, G. anisanthos, G. toppinii, G. reticulata, G. setifolia, G. olgae, G. bulbifera;* lanceolate to broadly lanceolate in *G. lutea, G. kunawarensis, G. persica.* In addition to radical leaves there are cauline leaves which can be distinguished from bracts in *G. persica, G. kunawarensis, G. anisanthos, G. improvisa, G. toppinii* and *G. lutea.* Lower part of the stem is mostly naked, and cauline leaves are formed in the upper part below the inflorescence. But in *G. pamirica,* and *G. bulbifera,* stem is leafy throughout. Cauline leaves are gradually smaller towards the inflorescence and change to bracts. It is lanceolate or linear and parallel-veined.

Inflorescence of *Gagea* varies from species to species. In some species inflorescence is a corymbose panicle with repeatedly branching peduncles, distinct internodes and solitary bract at the point of ramification, as in *G. minima, G. persica.* Compound corymb is reduced to simple raceme in *G. bulbifera* where internodes are distinct and pedicels are long. Next stage of reduction has taken place in the internodes. Longer and older pedicels are close to the younger shorter ones by reduction of the internodes above and form a condensed scorpioid cyme, looking like a fascicle as in *G. lutea.* Further reduction in this direction has led to formation of the umbel in *G. reticulata.* Umbel with older flowers below and young ones above shows its affinity with *Allium.*

Perianth is yellow with green outside in *G. lutea, G. reticulata, G. setifolia, G. improvisa* etc., yellow with brownish outside in *G. olgae,* and green in *G. bulbifera.* Perianth lobes are broadly lanceolate with obtuse apex in *G. lutea* or lanceolate with acute apex in *G. reticulata.* Anthers are broadly oblong in *G. kunawarensis* or oblong in *G. reticulata.* Style is as long as ovary or longer.

Capsules are generally broadly obovoid and trilobed. In *G. anisanthos* capsules are deeply triquetrous and concave at the top. Seeds are of two types: globose and subcompressed, on the basis of which Pascher (1905) divided the genus into two subgenera.

Inflorescence often bears large number of small bulbils in the axils of bracts, instead of producing flowers or flowering branch. As such bulbil bearing inflorescence of *G. kunawarensis* is different from the flower bearing inflorescence when they are sometimes treated as 2 distinct species. In normal flowering, bulbels are produced inside the bulb. It appears that production of bulbels inside the bulb is inversely proportional to the production of bulbils in the inflorescence. There may be one bulbil at the axil as in *G. kunawarensis.* Bulbil often produces radical leaf while still attached to the inflorescence.

As such formation of capsule and seed setting is reduced in the genus and reproduction is chiefly carried on by vegetative means.

Chromosome number: Chromosomes of different species of *Gagea* growing in Indian subcontinent have been studied by various workers. Chromosome number of *G. lutea* (L.) Ker-Gawl. has been reported as 2n = 72 by Tischler (1934), Westerguad (1936), Malik (1961), Masicek & Hronda (1974), Vachova & Majovsky (1978), and Vachova (1980); as 2n = 36 by Leute (1974), 2n = 96 and 132 by Kaul & Gohil (1973). Chromosome number has been reported as 2n = 24 in *G. reticulata* (Pall) Schults f. by Malik & Sehgal (1959), Heyn & Dafni (1971), Kaul & Gohil (l.c.); as 2n = 48 in *G. persica* Boiss by Mehra & Sachdeva (1971) and 2n = 72 (in *G. stipitata* Merckl. = *G. persica*) by Kaul & Gohil (l.c.) and *G. persica* Boiss. var. *kashmiriensis* (Turrill) Dasgupta & Deb as 2n = 24 by Kaul & Gohil (l.c.). 48 and 60 chromosome numbers have been reported by Kaul & Gohil (l.c.) in *G. kunawarensis* (D. Don) Grenter (= *G. dshungarica* Regel, *G. gageoides* (Zucc.) Vved.).

This wide occurrence of polyploidy appears to be the reason for less fruit formation and less seed setting.

INFRAGENERIC CLASSIFICATION OF THE GENUS *Gagea*

Salisbury (1806) while postulating the genus was in favour of subdividing *Gagea* but did not do so. C. Koch (1849) divided the genus into 2 groups: *Holobulbos* and *Didymobulbos* without indicating the rank, on the basis of number of daughter bulbs present inside the bulb and origin of scape inside. W.D.J. Koch (1857) divided the genus into 3 sections, on bulb characters, without giving names. Two of these tally with the grouping of C. Koch and third one was later named by Boissier (1882) as sect. *Tribolbos.* Boissier (l.c.) divided the genus into 4 sections on the bulb and seed character. He validated the names of the sections given by C. Koch and W.D.J. Koch and erected a new section *Platyspermum* separating some species from *Holobulbos.*

Pascher (1904 & 1905) divided the genus *Gagea* into two subgenera *Eugagea* and *Hornungia* on the basis of seed character. He subdivided the subgenus *Eugagea* into 4 sections following 3 of W.D.J. Koch and adding a new section *Monophyllos* distinguished from *Didymobulbos* (Pascher 1904). He also subdivided the subgenus *Hornungia* into section *Platyspermum* Boiss. (1882) and *Plerostigma* (Plectostigma Turcz. 1844), and further subdivided the sections into subsections etc. Pascher (l.c.) was followed by Krause (1930) in dividing the genus into subgenera and sections.

Terracciano (1905) followed Pascher (l.c.) in recognizing subgenera on seed character but named the subgenus *Hornungia* Pascher as *Gageastrum* Terracc. He divided the subgenera into sections, subsections and series of his own. Subgenus *Eugagea* Pascher was divided into two sections *Nudiscaposae* and *Foliatae* on number and arrangement of leaves and inflorescence characters. Subgenus *Gageastrum* Terracc. was divided into sections *Verticillatae* and *Anthericoides* on bulb and scape characters, the latter being placed under the genus *Lloydia.*

Grossheim (1935) in Flora U.S.S.R. followed Terracciano (l.c.) in dividing the subgenus *Eugagea* Pascher into sections, subsections, series etc. But named the other subgenus as *Platyspermum* (Boiss.) Miscz. (1913) (syn. *Hornungia* Pascher, *Gageastrum* Terracc.) and divided this into sections, subsections, series etc. following Pascher (l.c.). Series, subseries, cycles etc. divisions proposed by Pascher, Terracciano and Grossheim were not validly published.

Gagea is a genus reproducing mostly by vegetative means such as bulbs, bulbels and bulbils, and scarcely producing seeds. As such in many cases identification on seed character is not feasible.

Moreover, it is observed that many species so long kept in the subgenus *Platyspermum* (Boiss.) Miscz. (*Hornungia* Pascher) are more allied to the subgenus *Eugagea* Pascher (=*Gagea*), leaving aside the type.

Gagea gageoides (Zucc.) Vved. kept in the subgenus *Platyspermum* is bulbiliferous form of *G. dshungarica* Regel kept in the other subgenus *Eugagea,* the details of which along with nomenclatural aspect are discussed later.

12 species of *Gagea* distributed in the Indian subcontinent are grouped in two subgenera *Gagea* and *Hornungia* (Bernh.) Pascher.

KEY TO THE SUBGENERA SECTIONS AND SPECIES OF *Gagea*

1a. Flowers in loose panicle of corymb or scorpioid cyme or raceme or solitary. Bracts scattered on the inflorescence .... subgen. *Gagea*
  2a. Inflorescence loose panicle of corymb or racemose. Cauline leaves if more than 1, alternate .... sect. *Gagea*
    3a. Cauline leaves and bracts distinguishable. Stem naked below the inflorescence
      4a. Ovary sessile
        5a. Radical leaf linear to lanceolate. Anthers rotund or broadly oblong....1. *G. kunawarensis*
        5b. Radical leaf linear. Anthers oblong ...... 2. *G. improvisa*
      4b. Ovary stipitate ...... 3. *G. persica*
    3b. Cauline leaves and bracts indistinguishable. Stem not naked below the inflorescence.
      6a. Leaves without bulbiferous base. Perianth segments obtuse ......4. *G. olgae*
      6b. Leaves with bulbiferous base. Perianth segments acute
        7a. Flowers 3-4, in raceme. Pedicel long ..... 5. *G. bulbifera*
        7b. Flowers solitary, terminal. Pedicel short ..... 6. *G. pamirica*
  2b. Inflorescence scorpioid cyme. Cauline leaves 2, subopposite .... sect. *Holobulbos*
    8a. Cauline leaves lanceolate or broadly lanceolate. Outer perianth glabrous in-

side. Plants bigger (12-20 cm)
    9a. Ovary and capsule not depressed above. Radical leaf 1 .... 7. *G. lutea*
    9b. Ovary and capsule depressed above. Radical leaves 2 ... 8. *G. anisanthos*
  8b. Cauline leaves filiform. Outer perianth villous inside. Plants smaller (6-8 cm) ... 9. *G. toppinii*

1b. Flowers in umbel, rarely solitary. Bracts at the base of the inflorescence ... subgen. *Hornungia*
  10a. Cauline leaves straight, linear-lanceolate, many
    11a. Inflorescence terminal, longer (up to 6 cm long) ... 10. *G. reticulata*
    11b. Inflorescence lateral, shorter (up to 2 cm long) ... 11. *G. setifolia*
  10b. Cauline leaves curved, linear, few .... 12. *G. chitralensis*

Gagea Salisb. subgen. **Gagea**

Ornithoxanthum Link, Handb. 1: 161. 1829. *Bubillaria* Zucc. in Pl. Hort. Bot. Moench 3: 229. t. 2. 1843 (Type: *B. gageoides* Zucc.). *Gagea* Salisb. sect. *Platyspermum* Boiss. Fl. Or. 5: 203. 1882, pro parte, minore. *Gagea* Salisb. subgen. *Eugagea* Pascher in Lotos 24: 110. 1904; Terracc. in Soc. Bot. France Mem. 2. ser. 4, 5: 11. 1905; Krause in Engl. & Prantl, Nat. Pflanzenfam. ed. 2. 15a: 318. 1930; Grossh. in Komarov, Fl. U.S.S.R. 4: 69. 1935. *Gagea* Salisb. Subgen. *Hornungia* (Bernh.) Pascher in Lotos 24: 115. 1904, pro *G. bulbifera* and pro subsect. *Stipitatae* Pascher. *Gagea* Salisb. sect. *Nudiscaposae* Terracc. in Soc. Bot. France Mem. 2. ser. 4, 5: 11. 1905; Bull. L'Herb. Boiss. ser. 2, 5(11): 1062. 1905; Grossh. in Komarov, Fl. U.S.S.R. 4: 69. 1935.

Lectotype: *G. minima* (L.) Ker-Gawl.

Flowers in loose panicle of corymb or scorpioid cyme or raceme or rarely solitary and terminal. Bracts scattered in the inflorescence, single at the base of each of the ramification of the peduncle. *Cauline leaves* distinct and bigger than the bracts or indistinct and gradually decrease in size upwards; generally at the base of the inflorescence, often all over the stem.

Distribution: Throughout the range of the genus.

Gagea Salisb. sect. **Gagea**

Gagea Salisb. sect. *Didymobolbos* Koch in Linnaea 22: 226. 1849, pro parte; Boiss. Fl. Or. 5: 203. 1882; Pascher in Lotos 24: 111. 1904; Krause in Engl. & Prantl, Nat. Pflanzenfam. ed. 2. 15a: 318. 1930. *Gagea* Salisb. sect. *Platyspermum* Boiss. Fl. Or. 5: 203. 1882, pro *G. persica;* Pascher in Lotos 24: 118. 1904, pro subsect. *Stipitatae. Gagea* Salisb. sect. *Monophyllos* Pascher in Lotos 24: 113. 1904; Krause in Engl. & Prantl, Nat. Pflanzenfam. ed. 2. 15a: 319. 1930. *Gagea* Salisb. sect. *Nudiscaposae* Terracc. pro parte — *Unispathaceae* Terrecc. in Bull. L'Herb. Boiss. Ser. 2, 5(11): 1062. 1905.

Lectotype: *Gagea minima* (L.) Ker-Gawl.

Inflorescence much branched, loose, panicle of corymb. *Cauline leaf* 1 or 2 when alternate, below the inflorescence. Bracts at the base of each of the ramification of the division of the peduncle. Often lower flowers are replaced by bulbils at the axils of the bract. *Seeds* subcompressed.

Distribution: Eurasia through Afghanistan, Pakistan to N.W. Himalayas from Kashmir to H.P.

1. **G. kunawarensis** (D. Don) Grenter in Israel Journ. Bot. 19: 155. 1970.

Basionym: *Lloydia kunawarensis* D. Don in Royle Ill. 388. t. 93. f. 3. 1840 (Type: Chango in Kunawar, *Royle* LIV !). *Bulbillaria gageoides* Zucc. Pl. Hort. Bot. Moench 3: 230. t. 2. f. 1. 1843 (Type: Lebanon, 1838, *Roth* s.n. — Plate seen). *Gagea persica* Boiss.

Diagn. Ser. 1, 7: 108. 1846, pro parte (Type: Iran-Esfahan, *Aucher* 5404 BM — duplicate). *G. dshungarica* Regel in Act. Hort. Petrop. 6: 513. 1879 (Type: China-Dzungarian, 3-6000 ft, *A. Regel* LE); Pascher in Lotos 24: 113. 1904 & in Bull. Nat. Mosc. 4: 360. 1906; Grossh. in Komarov, Fl. U.S.S.R. 4: 75. 1935; Wendelb. in Koie & Rechinger, Symb. Afghan. 4: 159. 1958; Kachroo *et al.* Fl. Ladak. 157. 1977, *syn. nov. G. gageoides* (Zucc.) Vved. Fl. Turkm. 1(2): 261. 1932; Grossh. in Komarov. Fl. U.S.S.R. 4: 110. 1935; Wendelb. in Koie & Rechinger, Symb. Afghan. 4: 159. 1958, *syn. nov.* (Fig. 2).

Herbs 6-10 cm long; bulbs 0.6-1.5 x 0.4-1 cm, profusely rooting below; outer scales fibrous, dull brown; bulbels present or absent. *Radical leaf* 1, 6-10 x 0.4-0.8 cm, linear to lanceolate. Stem 4-6 cm, more or less as long as the leaf, terete, flexuous, naked below the inflorescence. *Cauline leaf* 1, below the inflorescence, 2-5 x 0.4-0.7 cm, linear, lanceolate or broadly lanceolate. *Inflorescence* panicle of corymb with many flowers or with many axillary bulbils and few flowers, each at the tip of a branch. *Flowers* golden yellow inside, pale green outside, campanulate, 5-6 mm long; pedicel 0.5-1 cm long, filiform; bracts many, 2-20 x 1-5 mm, linear-lanceolate, each enclosing a cluster of (10) bulbils except the top one. *Perianth* segments 4-6 x 1.5-2 mm, oblanceolate or elliptic, obtuse; veins 3-7. *Stamens* about as long as the perianth; filaments 3-5 x 0.5 mm, linear; anthers 0.7-1 x 0.7 mm, rotund or broadly oblong. *Ovary* sessile, 1.5-3 x 1-2 mm, obovoid, trilobed; style 2-2.5 mm; stigma 0.5 mm broad, truncate. Capsule obconical.

Flowering: April-August.

Fruiting: June-August.

Ecology: Dry slopes, open fields, gravelly places in foothills and in the middle mountain zone, on edges of snow line, at an altitude of 1700-3700 m. Bulbils are developed in the drier desert regions.

Distribution: W. Asia, C. Asia, Afghanistan and Pakistan to N. W. Himalayas in India. (Fig. 1).

Note: On study of the protologues, plates, and specimens identified by Wendelbo, Stewart, and Bornmuller, no significant distinction could be established amongst *Lloydia kunawarensis* D. Don, *G. gageoides* (Zucc.) Vyed. and *G. dshungarica* Regel, except the presence of numerous axillary bulbils in *G. gageoides. G. dshungarica* and *L. kunawarensis* with many flowered panicle of corymb without floral bulbils are conspecific.

Specimens collected by *T. Thomson* from N.W. Himalayas extant in CAL, BM, L, show both types — bulbils bearing *G. gageoides* and without bulbils *G. dshungarica* in the same gathering. Both of these represent the same species, and one is the bulbuliferous form of the other.

It is further observed that the branching of the inflorescence is often inhibited and flower production is reduced when numerous bulbils are produced. It is also observed that when axillary bulbils are developed in the inflorescence the underground bulbs do not develop bulbils inside, whereas many bulbels are present in the mother bulb when inflorescence is devoid of bulbil. Presence of bulbel inside the bulb is directly correlated with the absence of axillary bulbils. *Aucher* 5404 — Syntype of *G. persica* seen in BM is bulbuliferous — *G. kunawarensis.*

Herbarium specimens examined: INDIA: Kashmir, Baramula, *G. Watt* s.n. (BSIS); Kungwalan, *T. A. Rao* 9296 (BSD) & *G. Saran & party* s.n. (LWG); Liddar valley, *Inayat* 25765 (K); N.E. of Murgan Pass, *G. L. de La G. Fuller* 15 (K); Tanmarg, *P. Timins* 22 (BM); Pir Panjal, *J. E. Winterbottom* 109 (CAL); Balti, *J. E. Winterbottom* (CAL), *T. Thomson* s.n. (CAL, BM, L).

PAKISTAN: Darkot, *S. Bowes Lyon* 8085 (K); Chitral, *J. O. A. Stainton* 2338 (BM) & *S. A. Bowes Lyon* 623 (BM); Kagan valley, *Inayat* 20214 & 20215 (CAL).

IRAN: Kerman, *J. Bornmuller* 4740 (G); G. Shahrud — Bustan (Turam protected area) *K. H. Rechinger* 50431 (G); Monte Elwend, *Th. Pichler* (G, CAL).

2. **G. improvisa** Grossh. in Komarov, Fl. U.S.S.R. 4: 737. 2. 44. f. 1. a-c. 1935 (Type: Turkey- Ordubad, April, 1933, *T. Heideman* & *Prilipko* s.n. BAK). (Fig. 2).

Herbs 14-25 cm long; bulbs 2-2.5 x 0.8-1.5 cm; outer scales brown or brownish black, coriaceous; bulbels numerous inside the outer scales; sheath 0.5-0.7 cm long. *Radical leaves* 1, 14-22 x 0.4-0.5 cm, as long as the plant or longer, linear. Stem 10-15 cm long, glabrous, naked below. *Cauline leaves* alternate, distant, pass to bract, lower 3-5 x 0.4-0.5 cm, linear-lanceolate. *Inflorescence* panicle of corymb of 2-10 flowers. *Flowers* yellow, greenish outside, 8-12 mm long; pedicels 1-2 cm long; bracts 0.5-1 cm long, linear-lanceolate. *Perianth* segments 8-12 x 3-4.5 mm, elliptic, obtuse, 7 open veined. *Filaments* 4-5.5 x 1 mm, linear; anthers ± 2 x 1 mm, oblong. *Ovary* sessile, 4-4.5 x 1.5-2 mm, oblong; style 4-4.5 mm long; stigma 1 mm broad, trilobed.

Flowering: June.

Distribution: Turkey to Afghanistan and Pakistan at 3830 m in altitude. (Fig. 1).

Herbarium specimens examined: PAKISTAN: Chitral, *S. W. Bowes* Lyon 887 (BM). AFGHANISTAN: Badghis, *J. E. T. Aitchison* 1131 (CAL).

3. **G. persica** Boiss. Diagn. Pl. Or. Nov. 1(7): 108. 1846, pro parte (Type: Iran — Persepolis, *Kotschy* 237 — BM! CAL! G! K — photo!); Boiss. Fl. Or. 5: 210. 1882; Collett, Fl. Simlens. 599. 1902; Pascher in Lotos 24: 118. 1904; Bamber, Pl. Punj. 499. 1916. *G. stipitata* Merckl. ex Bunge in Mem. Acad. Petersb. 7: 512. 1851 (Type: Crimen-Bakali, *Lehmann* 1385 S) & in Ic. Regel Izv. Obshch. Lyubit. Estest. Antr. 1. Ethnogr. 21(2): 116. t. 19. 5-8, 1876; Regel in Act. Hort. Petrop. 3: 291. 1875; Grossh. in Komarov, Fl. U.S.S.R. 4: 109. 1935; Wendelb. in Koie & Rechinger, Symb. Afghan. 4: 160. 1958. *G. afghanica* Terracc. in Bull. Soc. Ort. Pelermo 2: 4. 1904 (Type: Turkmenistan-Krasnovodsk, *P. sintensis* 6 (G); Turkestan, Ajak, *Korolkow* LE; Afghanistan, Harirud valley, *Aitchinson* 1130 K); Pascher in Bull. Nat. Mosc. 14: 372. 1906; Grossh. in Komarov, Fl. U.S.S.R. 4: 107. 1935; Wendelb. in Koie & Rechinger, Symb. Afghan. 4: 158. 1958, *syn. nov.*

Herbs 14-23 cm long; bulbs 0.6-1 x 0.4-0.8 cm, profusely rooting below; outer scales dull brown, fibrous, bulbels inside. *Radical leaf* 1 or 2, 10-19 cm x 1 mm, linear; as long as inflorescence. Stem 11-23 cm long, terete, glabrous or hairy, naked. *Cauline leaves* 2, alternate, 1-5 x 0.2-0.4 cm, lanceolate or linear-lanceolate, glabrous or pilose. *Inflorescence* 3-14 cm long, loose panicle of corymb 3-10 flowers. *Flowers* yellow or white within, greenish or pinkish outside; pedicel 1-3.5 cm long, filiform; bracts 1-10 x 1-2 mm, linear, often hairy; sometimes flowers are replaced by bulbils. *Perianth* segments 4-11 x 1.5-3 mm, lanceolate, glabrous, acute, membraneous at the margin; veins 5-7, open, midvein prominent. *Stamens* nearly as long as perianth; filaments 3-5 x 0.5 mm, linear; anthers 1-2 x 0.7-1.5 mm, broadly oblong, or rotund, dorsifixed,

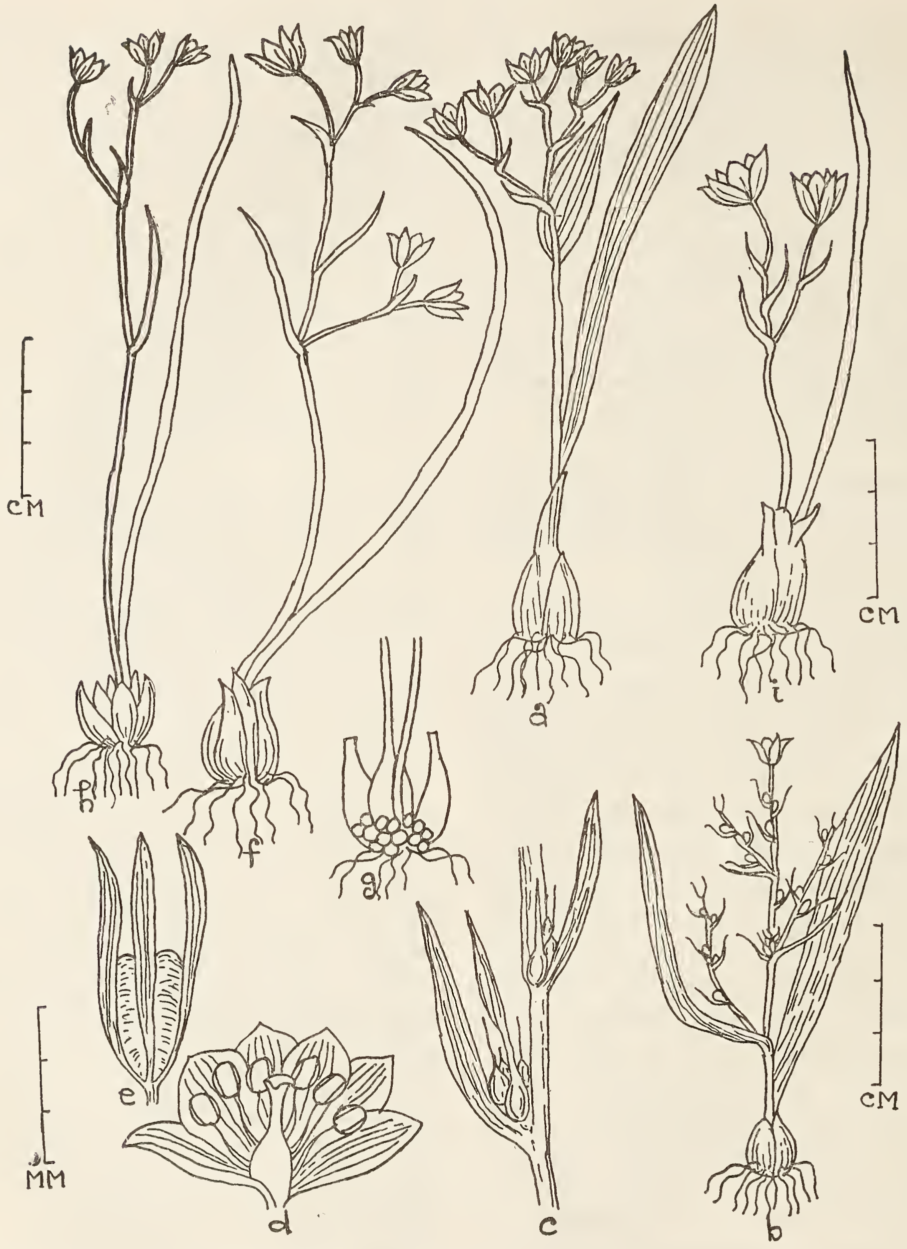

Fig. 2. *Gagea kunawarensis* (D. Don) Grenter — a) whole plant with flowers; b) whole plant with axillary bulbils; c) bulbils; d) flower showing different parts; e) capsule with persistent perianth. *G. improvisa* Grossh. f) whole plant; g) bulb scales removed, showing base of radical leaf and stem, outer scale and bulbels. *G. persica* Boiss — h) whole plant, *G. olgae* Regel — i) whole plant.

latrorse. *Ovary* stipitate, 2-3 x 1.5-2 mm, obovoid or obovoid-oblong, trilobed; style 2-3 mm long, linear; stigma trilobed. *Capsules* 5-6 mm long, obovoid, stipitate. *Seeds* many, subcompressed.

Note: Description and plate of *G. stipitata* Mercklin ex Bunge in Ic. Regel tally perfectly with the *Kotschy* 237.

Other syntype of *G. persica, Aucher Eley* 5404 is a different plant. *G. afghanica* was proposed by Terracciano as distinct from *G. stipitata* for perianth purple outside. But this is not tenable. As such, *G. stipitata* and *G. afghanica* are reduced to synonyms of *G. persica* Boiss.

KEY TO THE VARIETIES OF *G. persica*

1a. Stem glabrous. Radical leaf 1 ... a. var. *persica*

1b. Stem pilose. Radical leaves 2 ... b. var. *kashmiriensis*

a. var. **persica** (Fig. 2).

Bulbels many inside the outer scales of the bulb. *Radical leaf* 1, linear. *Stem* glabrous. *Cauline* leaves 2, alternate, glabrous, lower bigger. *Flowers* yellow or white within and greenish or pinkish outside, 5-8 mm long. *Capsules* obovoid, stipitate. *Seeds* many, subcompressed.

Flowering: April-July.

Fruiting: Not seen.

Ecology: Damp plains sometimes on metamorphic rocks at an altitude of 1524-3960 m.

Distribution: S. Russia, W. Asia to India in Kashmir and H. P. (Fig. 1).

Note: Capsule and seed characters were taken from Grossh. (l.c.).

Herbarium specimens examined: INDIA: Kashmir, *T. Thomson* 29 (CAL, L, BM), *Jaeschke* s.n. (CAL), *A. Meebold* 4115 (CAL), *B. O. Coventry* 1319 (K) & *P. N. Kohli* 36 (K). Himachal Pradesh, Spiti, *Stolickza* s.n. (CAL); Lahul, *Stolickza* s.n. (CAL), *Bhattacharya* 48602 (BSD), *Capt. Hay* (CAL) & *Walter Koeltz* (K). PAKISTAN: Murdar, *J. H. Lace* 3533 except one specimen (*G. setifolia*) (CAL); Quetta, *J. F. Duthie* 8725, 8726 (CAL), and 8727 (CAL, K); Chitral, *S. A. Bowes Lyon* 624 (BM). Iran: Persepolis, *Kotschy* 237 (CAL, G); Kernan-Kuhi, *J. Bornmuller* 4746 (G). Turkmenia: Askhabad, *P. sintensis* 43 (G).

b. **G. Persica** Boiss. var. **kashmiriensis** (Turrill) Dasgupta et Deb comb. et stat. nov.

Basionym: *Gagea kashmiriensis* Turrill in Kew Bull. 1928: 77. 1928 (Type: Kashmir, Srinagar, 5700 ft. *Canon stokoe* 2 holotype K — Photo !).

Daughter bulb 1, inside the outer scales of the bulb. *Radical leaves* 2, linear. *Stem hairy. Cauline leaves* 2, alternate, pilose, lanceolate. *Flowers* yellow, 7-11 mm long. *Capsules* not seen.

Flowering: March-July.

Altitude: 1524 m.

Distribution: Kashmir (Fig. 1).

Herbarium specimens examined: INDIA: Kashmir, *Rev. Jaeschke* s.n. (CAL), *Meebold* 4115 (CAL), *T. Thomson* 29 (CAL, L), and *B. O. Coventry* 1445 (L).

4. **G. olgae** Regel in Act. Hort. Petrop. 3: 292. 1875 (Type: Uzbekistan — Samarkand, *O. Fedchenko* LE; Turkestan — *Korolkow & Krause* LE); Merklin ex Bunge in Ic. Regel Izv. Obsheh. Lyubit. Estest. Antr. i. Etnogr. 21(2): 116. t. 18. f. 13-17. 1876; Pascher in Lotos 24: 117. 1904 & in Bull. Nat. Mosc. 4: 327. 1905; Grossh. in Komarov, Fl. U.S.S.R. 4: 106. 1935; Wendelb. in Koie & Reching. Symb. Afghan. 4: 159. 1958. *G. jaeshkei* Pascher in Lotos 24: 128. 1904 (Type: India — Himachal Pradesh, Keylang LE) & Bull. Nat. Mosc. 4: 371. 1905, *syn. nov.* (Fig. 2).

Plants 5-15 cm long; bulbs 1-2 x 0.5-1.5

cm, ovoid with a collar above and profuse roots below; outer scales fibrous; collar up to 3 cm long. *Radical leaf* 1, longer than stem, 6-18 x 0.1-0.25 cm, linear, glabrous. *Stem* 5-15 cm long, terete, glabrous or puberulous, leafy above. *Cauline leaves* alternate, linear; gradually diminishing in size upwards, not distinct from the bracts. *Inflorescence* terminal, 1-3-flowered, raceme. *Flowers* 8-18 mm long, campanulate, bright yellow, often brownish outside; pedicel 0.3-2.5 cm; bracts leafy. *Perianth* segments 8-18 x 2.5-3 mm, lanceolate or oblong, obtuse, scarious at margin; veins 3-7 diverging. *Filaments* ± 4 x 0.5 mm, linear; anthers ± 2 x 0.7 mm, linear — oblong. *Ovary* sessile, 3 x 1.5 mm, oblong; style 4 x 0.5 mm, linear; stigma trilobed. *Capsules* 6-8 mm long, obovoid.

Flowering: May-June.

Ecloogy: Stony hillsides, at an altitude of 3500-4200 m.

Distribution: C. Asia to Pakistan and India in W. Himalayas (Fig. 1).

Herbarium specimens examined: Pakistan: Chitral, *Bowes Lyon* 876, 733 & 1006 (BM); *J.D.A. Stainton* 2495 (BM);

5. **G. bulbifera** (Pall.) Salisb. in Konig & Sims. Ann. Bot. 2: 557. 1806; Schultes f. in Roem. et Schultes, Syst. Veg. 7: 552. 1829; Ledeb. Ic. Pl. Fl. Ross. 4: 142. 1829; Kunth, Enum. Pl. 4: 243. 1843; Boiss. Fl. Or. 5: 210. 1882; Pascher in Lotos 24: 115. 1904 & in Bull. Nat. Mosc. 4: 369. 1906; Miscz., Fl. Cauc. Grit. Ser. 3, 4: 174. 1913; Grossh. in Komarov, Fl. U.S.S.R. 4: 108. 1935.

Ornithogalum bulbiferum Pall. Reise 2(2): 736. t. Q. f. 2. 1776 (Type: U.S.S.R. — Astrakhan, *Pallas* LE; CAL — isotype! Linn. Suppl. 199. 1781; Reichenb. Icon. Fl. Germ. t. 117. 1846.

Plants small; bulbs 5-16 x 4-8 mm, outer brownish, fibrous, profusely rooting. *Radical leaf* single, 3-16 x 0.15 cm, linear. Stem 5-18 cm long, slender, glabrous. *Cauline leaves* 3-4, alternate, 1.5-6 cm, linear, shorter than inflorescence, gradually diminishing in size up the stem, bulging at base with a small bulbil inside the swelling. *Inflorescence* 3-4-flowered raceme. *Flowers* campanulate; pedicel 2-4 cm long, slender, nodding; bracts leafy. *Perianth* segments-outer green, inner greenish, 8-13 x 7.5-2 mm, lanceolate, scarious at margin, acute at apex, veins 7, diverging, midvein distinct. *Stamens* half as long as the perianth; filaments 5-7 mm, linear; anthers 1.25-2 x 0.75 mm, oblong. *Ovary* sessile, 3-4 x 1 mm, oblong, style 3.5-4.5 mm, linear; stigma trisulcate. *Capsules* ovoid, rounded, trigonous, half as long as the perianth.

Flowering: March-May.

Fruiting: Not seen.

Ecology: Gravelly slopes at an altitude of 1670 m.

Distribution: South U.S.S.R., C. Asia to India in Himachal Pradesh (Fig. 1).

Herbarium specimens examined: INDIA: Himachal Pradesh, Simla, *K. R. Johnson* (CAL) & *J. R. Drummond* 20926 (K); U.S.S.R.: Astrakhan, *Pallas* s.n. (CAL). C. Asia: Altai, *Gobler s.n.* (CAL).

Note: Description of fruit taken from Grossh. in Komarov, Fl. U.S.S.R. 4: 108. 1935.

6. **G. pamirica** Grossh. in Komarov, Fl. U.S.S.R. 4: 108 & 738. 1935 (Type: U.S.S.R. Fergana Pamir, Northern Slope, 12000 ft, 1.7.1901, *Alexeenko* s.n. LE); Wendelb. in Koie & Reiching. Symb. Afghan. 4: 160. 1958. (Fig. 4).

Plants 4-9 cm long; bulb 1-2 x 0.7-1 cm, profusely rooting below, bulb-scales fibrous. *Radical leaves* 2, 4-10 x 0.15-0.2 cm, linear. *Cauline leaves* many (15-16), 1-4 x 0.1 cm, gradually diminishing in size upwards, sparse below and closed above, ciliate at margin; bulbils at the axil of leaves, 1-1.5 x 1 mm. *Flowers* solitary, terminal, 11-15 mm long, campanulate; pedicel ± 2 mm long; bracts indistinct. *Perianth* segments 11-15 x 2.5-4 mm, broadly oblong, acute, 5-7-veined, scarious at margin. *Filaments* 2.5-6 mm, linear, attached at the base of the perianth; anthers 2-2.5 x 0.7 mm, linear-oblong. *Ovary* 4-6 x 1-1.5 mm, oblong, triquetrous; style 3-4 mm long, broader above, trigonous; stigma 1 mm broad, trilobed.

Flowering: June-July.

Ecology: Grassy and gravelly alpine zone at altitudes of 3695-3810 m.

Distribution: C. Asia in Pamir extending to Pakistan in Chitral (Fig. 1).

Herbarium specimens examined: Pakistan: Chitral, *Bowes Lyon* 878 (BM).

Gagea Salisb. sect. **Holobulbos** C. Koch in Linnaea 22: 226. 1849, pro parte — major; Boiss. Fl. Or. 5: 203. 1882; Pascher in Lotos 24: 113. 1904; Krause in Engl. & Prantl, Nat. Pflanzenfam. ed. 2. 15a: 318. 1930. *Gagea* Salisb. sect. *Didymobulbos C.* Koch. in. Linnaea 22: 226. 1849, pro parte — major; Boiss. Fl. Or. 5: 203. 1882; Pascher in Lotos 24: 111. 1904; Krause in Engl. & Prantl, Nat. Pflanzenfam. ed. 2. 15a: 318. 1930. *Gagea* Salisb. sect. *Tribolbos* W.D.J. Koch, Syn. Fl. Germ. 2: 619. 1857; Boiss. Fl. Or. 5: 203. 1888. *Gagea* Salisb. sect. *Nudiscaposae* Terracc. in Soc. Bot. France Mem. 2. ser. 4, 5: 12. 1905, pro subsect. *Dispathaceae.*

Lectotype: *G. lutea* (L.) Ker-Gawl.

Inflorescence condensed scorpioid cyme *Cauline leaves* 2, subopposite, distinct from leaves, lower bigger, as long as the inflorescence. Pedicel long. Daughter bulb present or not. *Seeds* not compressed.

Distribution: From Afghanistan, Pakistan to Himalayas in the states of Kashmir, H.P., U.P. to Nepal, Sikkim.

7. **G. lutea** (L.) Ker-Gawl. in Curtis' Bot. Mag. 30: t. 1200. 1809; Schultes f. in Roem. & Schultes, Syst. Veg. 7: 538. 1829; Kunth, Enum. Pl. 4: 235. 1843; Boiss. Fl. Or. 5: 207. 1882; Hook. f. Fl. Brit. Ind. 6: 355. 1892; Collett, Fl. Simlens. 529. 1902; Pascher in Lotos 24: 114. 1904; Terracc. in Bull. L'Herb. Boiss. ser. 2, 5(11): 1070. 1905; Bamber, Pl. Punj. 498. 1916; Blatter, Beaut. Fl. Kashmir 2: 170. 1928; Grossh. in Komarov, Fl. U.S.S.R. 4: 78. 1935. *Ornithogalum luteum* L. Sp. Pl. 306. 1753 (Type: Upsala, *Linn.* 428.4 LINN). *G. fascicularis* Salisb. in Kon. & Sims. Ann. 2: 555. 1806 (Type: Greta Bridge, *H. Johnson* s.n.; Tubingen, *Fuchs s.n.*; Woodstock — *J. Banks s.n.* K, BM — duplicate of the Paratype !). *G. elegans* Wall. ex D. Don in Royle, Illustr. Bot. Himal. 388. t. 95. f. l. 1840 (Type: Kumaon, Wall. Cat. 5065, K-W Photo! BM!); Pascher in Lotos 24: 114. 1904; Terracc. in Bull. L'Herb. Boiss. ser. 2, 5(11): 1068. 1905; Pascher in Bull. Nat. Mosc. 14: 364. 1906. *G. indica* Pascher in Fedde Repert. 2: 111. 1906 (Type: India Boreales — Himalaya LE) & in Bull. Nat. Mosc. 19: 364. 1906, *syn. nov. G. lowariensis* Pascher in Fedde Repert. 2: 111. 1906 (Type: Chitral, Lowari Pass, *Harriss* 16699, pro parte K Photo! CAL — duplicate of the type!) & in Bull. Nat. Mosc. 4: 364. 1906; Wendelb. in Koie & Reching. Symb. Afghan. 4: 159. 1958, *syn. nov. G. moorcroftiana* Wall. Cat. 5063, nom. nud. *G. pulchella* Wall. Cat. 5064, nom. nud. (Fig. 3).

Herbs small, gregarious; bulbs deep brown, 1-3 x 0.5-2 cm, ovoid or subglobose, profusely rooting below; outer scales black in colour, bulbels many, inside. *Radical leaf* solitary, 6-35 x 0.2-2 cm, linear-lanceolate to broadly lanceolate, acute, glossy, overtopping the inflorescence. *Stem* 5-22 cm, terete, naked. *Cauline leaves* 2, enclosing the inflorescence, subopposite, 3-8 x 0.3-1 cm, lanceolate or broadly lanceolate, lanate inside. *Inflorescence* compressed scorpioid cyme, up to 7-flowered, 0.5-2 cm long, lowest overtop the whole inflorescence. Flowers ascending, 9-14 mm long, broadly campanulate; pedicel 1.5-6 cm, linear often lanate; bracts 1.5-3.0 x 0.3-0.5 cm, one at each node, linear. *Perianth* segments persistent, bright yellow within, externally green with yellow margin, 9-14 x 2-3.5 mm, lanceolate or broadly lanceolate, obtuse, glabrous, scarious at margin; veins 7, open, midvein prominent. *Filaments* yellow, subulate; 3-8 mm long, unequal, anthers orange, varying in size, 1-2.5 x 0.5-1 mm, linear-oblong or oblong, latrorse. *Ovary* green, sessile, 2-4 x 1.5-2 mm, obovoid or obovoid-oblong, not depressed above; style pale green, 4-7 mm long, linear trisulcate; stigma truncate, trilobed, obscurely papillose. *Capsules* 4-6 x 5-6 mm, broadly obovoid, trilocular. *Seeds* 4 per locule, 2-3 x 1-1.5 mm, hemispherical or semi-rotund, wingless.

Flowering & fruiting: April to July.

Ecology: Open grassy hillside or humus rich plateau, in alpine forest at 2744-4270 m in altitude.

Distribution: Pakistan to India, along Himalayas in Kashmir, H.P., U.P. to Nepal and Sikkim. (Fig. 1).

Note: Originally *G. indica* Pascher was distinguished for the linear, hooded radical leaf, the ovate cauline leaf and the few-flowered inflorescence. *G. lowariensis* Pascher was distinguished for the broadly lanceolate (18-25 mm broad) radical leaf, the broadly elliptic cauline leaf and many-flowered inflorescence. Elliptic cauline leaves, many-flowered inflorescence and oblong or obovoid-oblong, acute perianth are the distinguishing characters of *Gagea lutea* (L.) Ker-Gawl. After examination of specimens it is observed that leaves are hooded in young stage but become spreading on maturity. Linear radical leaves, lanceolate cauline leaves associated with many flowers are seen in *Parker* 367, *Mackinnon* s.n., linear radical leaves, lanceolate cauline leaves associated with few flowers in *Strachey & Winterbottom* 62. Radical leaves of various breadth intermediate between *G. lutea* and *G. lowariensis* are seen in *T. A. Rao* 9308 and duplicate of the holotype of *Harriss* 16699. In view of the intergrading characters the distinction of these three species is not tenable and are conspecific.

Particulars of some specimens are given below

Specimens	Radical leaves	Cauline leaves	Flowers
Kashmir, *Parker* 367 (CAL)	23-30 x 0.6-0.8 cm linear	8-9 x 1.2-1.5 cm lanceolate	7
N.W. Himalaya *Mackinnon* s.n. (CAL)	26-35 x ±1 cm linear	± 9 x 1 cm lanceolate	6
Kumaon, *Strachey & Winterbottom* 62 (CAL)	± 18 x 0.5 cm linear	± 3 x 0.5 cm lanceolate	2–3
Kashmir, *T. A. Rao* 9308 (CAL)	12-15 x 1-1.2 cm linear-lanceolate	± 4 x 1 cm broadly lanceolate	3–4
Chitral, *Harriss* 16699 (CAL)	18-19 x 1.5-1.7 cm lanceolate	± 7.5 x 1.5 cm broadly lanceolate	6

Herbarium specimens examined: INDIA: Uttar Pradesh, Kumaon, *R. Blinksworth* s.n. in Wall. Cat. 5065 (CAL), *Strachey & Winterbottom* 62 (CAL, BM); *Awasthi* s.n. (LWG), and *Balapmet & Pandey* 93361 (LWG); Tehrigarhwal, *M. A. Rau* 51651 (BSD), *N. C. Nair* 36787 (BSD), *Y. K. Sarin & M. A. Rau* 2918 (BSD), *W. Gattan* s.n. (CAL); *Duthie* 1278 (CAL) and *Haines* 2186 (K). Kashmir, Pirpanjal, *Winterbottom* 92 (CAL); Chenab, *Baden Powell* 311 (CAL), *R. Ellis* 1033 (CAL), Mulluk & South of Bhabeh Pass, *Stolizka* s.n. (CAL); Kajnag range, *Duthie* 11002 (CAL); Gulmarg, *A.K.K.* 9 (CAL), *Thaplyal & Raizada* 26447 (L); *Khilenmarg, Singh* 277 (L), Jajpal, *M. A. Enershed* s.n. (BM); Gilgit, *G. M. Giles* 128 (CAL), Kinimonala, *Inayat* s.n. (K); Kungwalan, *T. A. Rao* 9308 (CAL, BSD), Himachal Pradesh, Lahul, *Brandis* s.n. (CAL) & *M. A. Rau* 5865 (BSD); Chamba, *R. Ellis* s.n. (CAL), *J. H. Lace* 1319 (BSIS) and *N. C. Nair* 32444 (BSD); Narkanda, *M. A. Rau* 11448 (BSD); Rohtang, *Stolizka* s.n. (CAL); Lectee, *Vicary* s.n. (CAL); Simla hills, *I. H. Burkill* 28661 (BSIS); Kunwar, *Drummond* 26542 (K); N. W. Himalayas, *T. Thomson* 39 (CAL), *A. B. Royle* s.n. (CAL); *Mackinon* s.n. (CAL). Sikkim: Thangu, *K. Biswas* 6993 (CAL); Lachen, *L. L. Terner* s.n. (BSIS); Soonderdunga glacier, *T. Anderson* s.n. (CAL). Nepal: Padmara Lagna, *Polunin, Sykes & Williams* 4065 (CAL); Dozamkhola, *Polunin, Sykes & Williams* 4233 (BM, CAL); Balangra Pass, *Polunin, Sykes & Williams* 1013 (BM); Near Dogadikhola, *Stainton, Sykes & Williams* 3179 (CAL); Tara Kot, *J. F. Dobremej* 162 (BM); Opikhola, *J. B. Tyson* 19 (BM); Saurekhola, *A. R. Vickary* 810 (BM). Pakistan: Chitral, *Stainton* 2331 & 2759 (BM), *Surg. Lt. Harriss* 16697, 16698 & 16699 (CAL, BM, K); Hazara, Kagan, *Inayat* 20211, 20212, 20213 & 22620 (CAL), *Duthie* 22620 (K), *Stewart* 222 (CAL); Jaunsar, *Gamble* 23125, 25935 (K); *A. Webb* (BSIS), *W. Gottan* 2089 (CAL, BM); Doab, *Wall. Cat.* 3065 (BM).

8. **G. anisanthos** C. Koch in Linnaea 22: 230. 1849 (Type: S. Russia — *Lelwar, Koch* ER); Ledeb. Fl. Ross. 4: 140. 1852; Terracc. Bull. L'Herb. Boiss. Ser. 2, 5(12): 1119. 1905; Miscz. Fl. Cauc. Crit. Ser. 2, 4: 156. 1912; Grossh. in Komarov, Fl. U.S.S.R. 4: 87. 1935. *G. liottardi* Boiss. Fl. Or. 5: 204. 1882. *G. fistulosa* Miscz. in Fl. Cauc. Crit. Ser. 2, 4: 154. 1912. (Fig. 3).

Herbs 12-20 cm; bulbs brown, 6-8 x 5-6 mm; bulbel 1 or 2. Stem 7-15 x 0.2 cm, glabrous. *Radical leaves* 2, 15-20 x 0.2-0.3 cm, exceeding the inflorescence, linear, glabrous. *Cauline leaves* 2, subopposite, enclosing the inflorescence, lower longer than the upper, 4-8 x 0.3-0.6 cm, lanceolate, broader at the base, sheathing, plicate, glabrous. *Inflorescence* 2-8-flowered, condensed scorpioid cyme. *Flowers* 15-20 mm long, campanulate; pedicel diverging, 3-9 cm long, villous; bracts 1.5-4 x 0.2-0.3 cm, linear, glabrous. *Perianth* segments yellow, 1.5-2.0 x 0.4 cm, elliptic-lanceolate, subacute; margin revolute; veins 7, diverging. *Stamens* shorter than pistil and half the length of perianth; filaments 5-9 x 0.5-1 mm, linear; anthers ± 2 x 0.7-1 mm, oblong. *Ovary* sessile, 5-8 x 3-4 mm, obovoid-triquetrous, depressed above; style short, 3-4 mm, stout; stigma 1-1.5 mm broad. *Capsules* 8.5-9.5 mm, obovoid, triquetrous, depressed above. *Seeds* 2 x 1.25 mm, ovoid, neither compressed nor angular, deep brown, wingless.

Flowering: April-May.

Fruiting: May.

Distribution: W. Asia, S. Russia to Kashmir at 2438 m in altitude (Fig. 1).

Herbarium specimens examined: INDIA: Kashmir, Baspassi Pass, *J. E. Winterbottom* 222 (CAL); Sonemarg, *W. F. Saxton* 1662 (CAL); Gulmarg, *B. O. Coventry* 1466 (K);

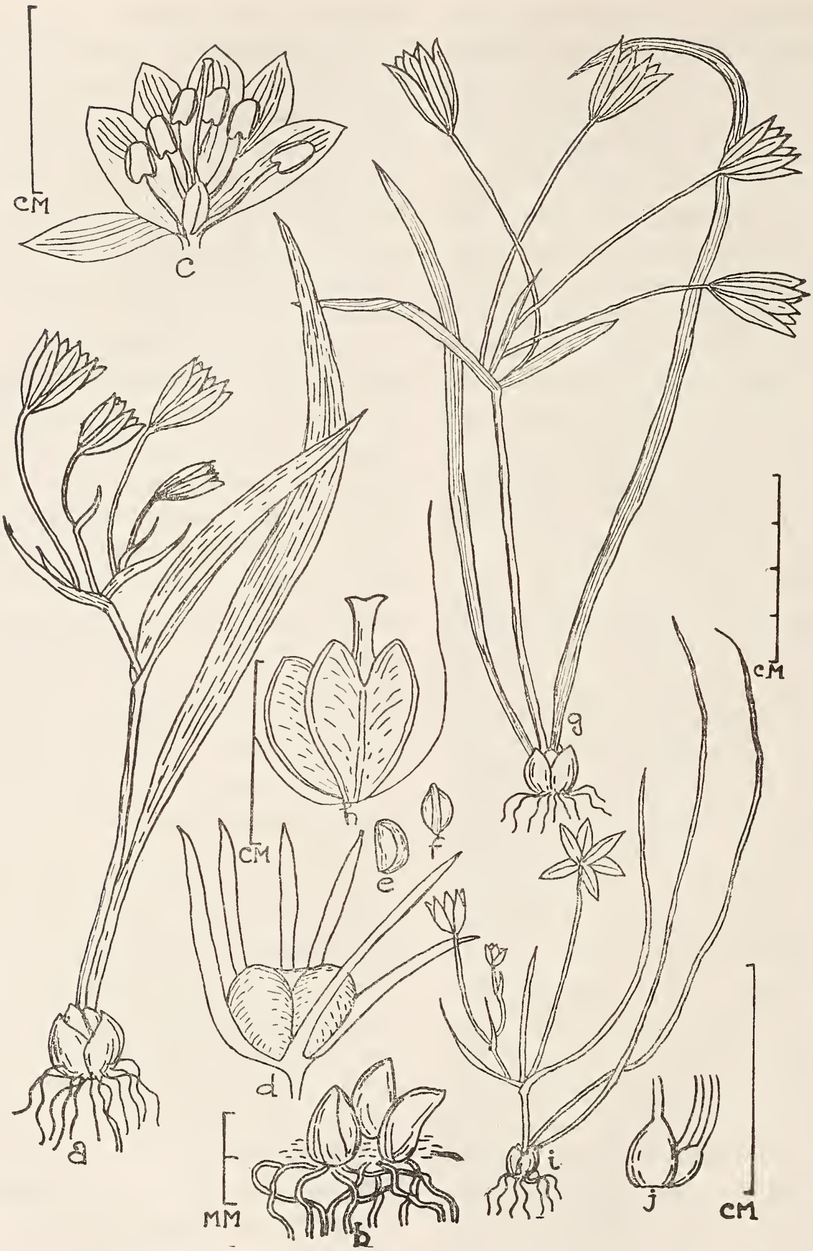

Fig. 3. *Gagea lutea* (L.) Ker-Gawl — a) whole plant; b) bulbs; c) flower showing different parts; d) capsule with persistent perianth; e & f) seed. *G. anisanthos C.* Koch — g) whole plant; h) capsule. *G. toppinii* sp. nov. — i) whole plant; j) dissected bulb showing radical leaf base, stem base and a bulbel.

Chandanweri, *P. R. Dahadghao* 0368 (CAL). Jordon — *Lyon* s.n. (CAL).

9. **G. toppinii** sp. nov. Differt ab. *G. lutea* (L.) Ker-Gawl. foliis caulinis leariibus, foliis radicalibus bulbiferibusque ubi affixis in plantis maturis, perianthiisque exteriore villosis; ab. *G. anisanthos* C. Koch statura multo minore, perianthiis exteriore villosis, ovariis supra non depressis. Typus: Pakistan, Chitral, *Major S. N. Toppin* 17 (holotypus K) (Fig. 3).

Herbs 6-8 cm long; bulb 4-5 x 3-4 mm, ovoid; bulbel 1 or 2 often bearing leaves when still attached to the mother plant. *Radical leaves* 10-11 x 0.01 cm, linear, acute at the apex, glabrous, overtopping the inflorescence. *Stem* 1.5-2 cm terete, pubescent. *Cauline leaves* subopposite, at the base of the inflorescence, 1.5-5 cm long, filiform, about 1 mm broad at the base, the lower over-topping the inflorescence. *Inflorescence* 2-4-flowered condensed scorpioid cyme. *Flowers* broadly campanulate; pedicel 3-6 cm long, filiform, pubescent; bracts 3-5 mm long, filiform. *Perianth segments* 7-8 x 1.7-2 mm, lanceolate, acute at the apex, midvein prominent, dorsal side of outer segments pubescent. *Filaments* ± 4 x 0.5 mm, linear; anthers ± 1.2 x 1 mm, oblong. *Ovary* sessile, 3-3.5 x 1, oblong, triquetrous; style 3-3.5 x 0.5, linear, triquetrous; stigma trifid. *Fruit* not seen.

Distribution: Pakistan, Chitral (Fig 1).

Gagea Salisb. subgen. **Hornungia** (Bernh.) Pascher in Lotos 24: 115. 1904, pro subsect. *Reticulatae*-pro parte; Krause in Engl. & Prantl. Nat. Pflanzenfam. ed. 2. 15a: 318. 1930. *Hornungia* Bernh. in Flora 23: 392. 1840 (Type: *H. circinata* Bernh.). *Gagea* Salisb. sect. *Platyspermum* Boiss. Fl. Or. 5: 203. 1882 (Type: *Gagea reticulata* (Pall.) Schultes f.). *Gagea* Salisb. subgen. *Gageastrum* Terracc. in Soc. Bot. France Mem. 2. ser 4, t. 5. 21. 1903, pro sect. *Verticillatae* Terracc. (Type: *Gagea reticulata* (Pall.) Schultes f.). *Gagea* Salisb. subgen. *Platyspermum* (Sciss.) Miscz. Fl. Cauc. Crit. ser. 2, 4: 169. 1913; Grossh. in Komarov, Fl. U.S.S.R. 4: 94. 1935.

Type: *Gagea reticulata* (Pall.) Schultes f.

Inflorescence umbel, rarely solitary, apical. Bracts arising from a single node at the base of the umbel. *Cauline leaves* not distinct from the bracts. *Scape* naked from the bulb to the inflorescence. *Perianth* acuminate. *Ovary* oblong, sessile. *Seeds* compressed.

Distribution: Russia, C. Asian desert to Afghanistan, Pakistan and India in W. Himalaya.

10. **G. reticulata** (Pall.) Schultes f. Syst. Veg. 7: 542. 1829; Kunth, Enum. Pl. 4: 238. 1843; Regel et Bunge, Fl. Turkest. Icon. 19: 1-4. 1876; Boiss. Fl. Or. 5: 208. 1882; Hook. f. Fl. Brit. Ind. 4: 355. 1892; Collett, Fl. Simlens, 529. 1902; Pascher in Lotos 24: 115. 1904 & in Bull. Nat. Mosc. 4: 366. 1906; Terracc. in Soc. Bot. France Mem. 2. ser. 4, 5: 21. 1905; Bamber, Pl. Punj. 499. 1916; Vved. in Fl. Turkm. 1(2): 268. 1932; Grossh. in Komarov, Fl. U.S.S.R. 4: 54. 1935.

Basionym *Ornithogalum reticulatum* Pall. Reise 3: 727. t. d. f. 2. 1776 (Type: U.S.S.R. — Astrakhan desert, *P. S. Pallas* LE, BM). *O. circinatum* Linn. Suppl. 199. 1781 (Type: U.S.S.R.-Astrakhan desert, *Pallas* LE, BM, LINN). *G. reticularis* (Pall.) Salisb. in Kon. & Sims. Ann. Bot. 2: 557. 1806. *G. commutata* C. Koch in Linnaea 22: 227. 1849 (Type: S. Russia, *C. Koch* B). *G. triphylla* C. Koch l.c. 229 (Type: S. Russia, *C. Koch* B). *G. sermantosa* C. Koch l.c. 230 (Type: S. Russia, *C. Koch* B). *G. pseudoreticulata* Vved. in Fl. Turkm. 1(2): 268. 1932 (Type: U.S.S.R.-Turkmenistan, *Regel* LE); Grossh. in Komarov, Fl. U.S.S.R. 4: 100. 1935; Wendelb. in Koie & Reching. Symb. Afghan. 4: 160. 1958, *syn. nov. G. pedunculata* Wall. Cat. 5066, nom. nud. (Fig. 4).

Herbs 5-21 cm long; bulbs 4-12 x 2-6 mm, ovoid or elongated ovoid, rooting below; outer scales brown, fibrous; bulbels 1 or 2, often with leaves. *Radical leaf* 1, 5-16 cm, much longer than the stem when young, linear, terete. Stem 1-15 cm long, finely hairy, naked, linear. *Cauline leaves* 4-6, at the base of the inflorescence, linear-lanceolate, straight, not distinct from the bracts. Inflorescence terminal umbel, up to 20 flowered. *Flowers* yellow with greenish apex and green band outside, small, campanulate; pedicel 1.5-6 cm long, linear, finely hairy; bracts at the base of the inflorescence, foliaceous, up to 7 x 0.2 cm, linear, plicate. *Perianth* segments 9-15 x 1.5-2 mm, lanceolate, acute, thin; pubescent outside, scarious at margin; veins many. *Filaments* unequal, 4-6 x 0.5 mm, linear; anthers 1.5-2 x 0.5-0.7 mm, narrowly oblong. *Ovary* sessile, 2-3 x 1-1.5 mm, oblong, or obovate-oblong; style 4-5 mm, trisulcate. *Capsules* deep brown dull, ± 6 x 3 mm, obovoid, or oblong, trigonous; pericarp thin, 6-ribbed. *Seeds* deep brown, 1 x 0.7 mm, triangular, compressed, thickly margined.

Flowering: February-April.

Fruiting: March-July.

Ecology: In soil formed from Tertiary calcium carbonate rock debris or desert silt, in gorges or beside winter torrents with grass, at an altitude of 400-2895 m.

Distribution: Desert region of S. Russia and C. Asia to Afghanistan, Pakistan and India in W. Himalaya. (Fig. 1).

Note: *G. pseudoreticulata* was distinguished from *G. reticulata* by the absence of sheathing bulb-scales below the stem. This character is variable due to ecological condition, and does not have any taxonomic significance.

Herbarium specimens examined: INDIA: Kashmir, Gilgit, *G. M. Giles* 113 (CAL). Himachal Pradesh, Chamba, *Lace* 1884 (BSIS); Kangra, *Drummond* 1747 (K). Uttar Pradesh, Dehradun, *Gamble* 22634 (K); *P. W. Mackinon* s.n. (CAL); *Kurz* (CAL).

PAKISTAN: Kohat Pass, 23/HBK (CAL); Chitral, *Younghusband* 1594 (CAL); Kurram, *Harol Dean* (K); Peshwar, *J. H. Lace* 3499 (CAL); Lahore-Gujerat, *Baden Powell* (CAL), Rawalpindi, *R. R. Stewart* 4 (K) & *B. O. Coventry* 806 (K); Basal, 1945, *R. S. Byles* (K); Baluchistan-Afghanistan Boundary, *Surgeon Capt. F. P. Maynard* 17e (CAL); Quetta, *J. F. Duthie* 8272 (CAL, BM).

11. **G. setifolia** Baker in Journ. Linn. Soc. 18: 101. 1880 (Type: Afghanistan, Kurrum valley, Alikhel, 17.4.1879, *Aitchison* 104 K — Photo!); Boiss. Fl. Or. 5: 211. 1882; Pascher in Bull. Nat. Mosc. 4: 368. 1905; Wendelb. in Koie & Rechinger, Symb. Afghan. 4: 160. 1958. (Fig. 4).

Herbs 8-16 cm long; bulbs 1.5-2 x 1-1.2 cm, profusely rooting below, outer scales scarious. *Radical leaf* 1, 12-16 x 0.15 cm, linear. Stem naked below, leafy at the base of the inflorescence, minutely pilose below. *Cauline leaves* many, crowded at the base of the inflorescence; lowest 3-5 x 0.3-0.4 cm, linear-lanceolate, straight, acute, sheathing; others 1-3 x 0.1-0.2 cm, linear, bract-like. *Inflorescence* umbel of 2-3 flowers, oldest on one side of the stem. *Flowers* yellow inside, green outside; pedicel 0.5-2 cm long, longest near the lowest cauline leaf; bract indistinct from cauline leaves. *Perianth* segments 15-16 x 2-3 mm, lanceolate, inner acute, outer plicate at the tip. *Filaments* 5-6 x 0.7 mm, subulate; anthers 2-3 x 0.7-1 mm, linear oblong. *Ovary* sessile, ± 4 x 1 mm, oblong, trilocular; ovules

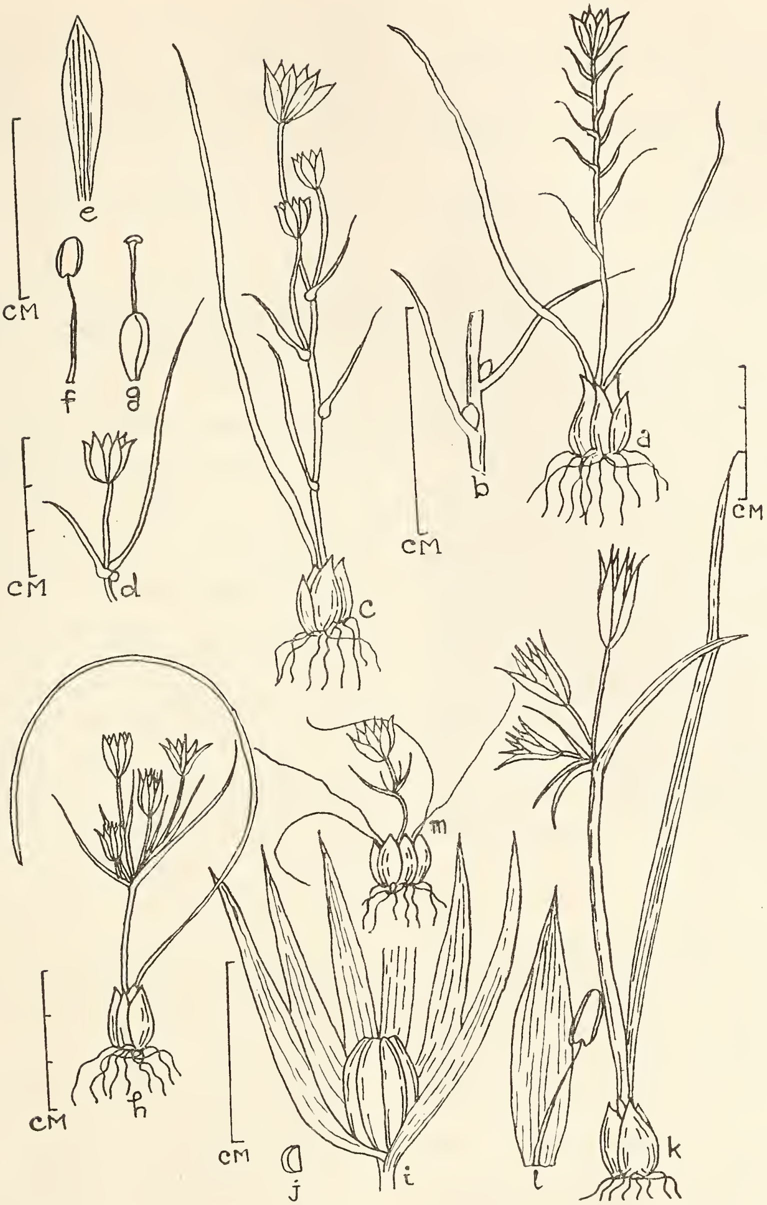

Fig. 4. *Gagea pamirica* Grossh. — a) whole plant; b) Axillary bulbils. *G. bulbifera* (Pall.) Salisb. — c) whole plant; d) bulbiferous leaf base; e) Perianth segment; f) Stamen; g) Pistil. *G. reticulata* (Pall.) Schultes f. — h) whole plant; i) capsule with persistent perianth; j) seed. *G. setifolia* Baker — k) whole plant; l) Perianth segment with a stamen. *G. chitralensis* Dasgupta & Deb — m) whole plant.

biseriate, 12-18 in each locule; style 5-6 mm long, linear; stigma 0.5 mm broad, truncate.

Flowering: April-July.

Ecology: Amongst snow-boulders at an altitude of 3960 m.

Distribution: Western Asia extending to India in Kashmir (Fig. 1).

Herbarium specimens examined: INDIA: Kashmir-Gilgit, *G. M. Giles* (CAL). PAKISTAN: Chitral, *J. D. A. Stainton* 2847 (BM).

12. **G. chitralensis** Dasgupta & Deb in Candallea 38: 477. 1983. Type: Pakistan, Chitral, *Bowes Lyon* 611 (BM) — Holo; Tashkhent, *Vvedensky* 53 (CAL) — Para. (Fig. 4).

Herbs 2-5 cm long; bulbs 4-6 x 2-3 mm, brown, with bulbels. *Radical leaves* 4-8 x ±0.05 cm, linear, exceeding the floral shoot. Stem small, terete, glabrous. *Cauline leaves* indistinct from the bracts. *Flower solitary,* 7-8 mm long; pedicel upto 2 cm long, filiform, glabrous; bracts 4, up to 15 x 0.7 mm, foliaceous, linear. *Perianth segments* 7-8 x 1.5-2 mm, lanceolate, glabrous, acute with 3 median veins, outer narrower, shorter. *Filaments* 4-4.5 x 0.5 mm, subulate; anthers ± 1.5 x 0.7 mm, oblong. *Ovary* sessile, 3-3.5 x 0.5-0.7 mm, narrowly oblong; style ± 7.5 x 0.5 mm. *Fruit* not seen.

Flowering: March.

Distribution: S. Russia to Pakistan (Fig. 1).

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FEEDING ECOLOGY OF THE BONNET MACAQUE AT THE MUNDANTHURAI SANCTUARY, TAMILNADU[1]

RAUF ALI[2]

(*With three text-figures*)

The feeding ecology of the Bonnet Macaque (*Macaca radiata diluta*) is discussed. 68 plant species were observed being eaten, but this is nowhere near the maximum. Fruits and insects constituted the bulk of the diet. Super abundant food sources like fruiting fig trees accounted for the majority of feeding observations.

Various propositions dealing with aspects of feeding behaviour are examined.

INTRODUCTION

Many potential causes affect feeding behaviour in primates. There is a constant interaction between the distribution of food resources, and the utilisation of these resources by the primates in that area. Previous studies have highlighted various factors that affect feeding. Among these are the need to increase the diversity of the food items eaten (Marsh 1978) and the need to avoid compounds in plant material that are potentially poisonous to the monkey, such as the various alkaloids and tannins normally present in leaf material (McKey 1978, Oates, *pers. comm.*) Some primates such as the Nilgiri Langur, have been shown to select food material which is easily chewed (Oates, *pers. comm.*). Competition between various species in the area may be a factor.

The bonnet macaque has been shown in previous studies to be largely fruit-eating, with a large component of insects in its diet (Nolte 1955, Simonds 1965, Kuruvilla 1976). However, the first two studies concentrated on roadside troops of bonnet macaques, which had adapted to living in man-modified areas. Kuruvilla studied a northern population on Elephanta island. I report below on a study conducted at the Mundanthurai Sanctuary in Tamil Nadu, on the southern race *Macaca radiata diluta*. Observations were made intensively on one group of bonnet macaques between February 1977 and April 1978 at this site.

DESCRIPTION OF STUDY AREA

The study area was at Mundanthurai, in the Mundanthurai Sanctuary in Tamil Nadu. The group ranged along the banks of the Thambraparni and Servalar rivers, at an altitude of 180 m (*c.* 8°40′N, 77°28′E). The vegetational patterning of the study area is complex. Along the river banks, the flora is typical of forest normally found at a higher altitude, and based on species composition could be classified as dry evergreen (Champion and Seth 1962). The commonly occurring large tree species in the area are *Pongamia glabra, Hopea utilis, Callophyllum elatum, Mangifera indica, Syzygium cumini, Mesua ferrea,* and *Hopea parviflora.* The medium and small trees include species such as *Walsura piscida, Aglaia roxburghiana,*

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[1] Accepted December 1982.

[2] Auroville Centre, S. Arcot, 605 101, Tamil Nadu.

Diospyros peregrina, Diospyros montana, Memecylon angustifolium, Vitex leucoxylon and *Syzygium lineare*, an endemic locally very common along the river bank. *Glycosmis pentaphylla, Tetracera laevis* and *Pandanus tectorius* are the commonest shrubs along the river bank.

Away from the river, the vegetation changes, being more characteristic of a dry mixed deciduous type. The most frequently occurring trees and shrubs are *Randia malabarica* and *Limonia alata. Atalantia monophylla*, neem (*Azadirachta indica*), tamarind (*Tamarindus indicus*), *Orophoea thompsonii* and *Alphonsea sclerocarpa* are also abundant. *Chloroxylon swietenia, Dalbergia latifolia, Terminalia, bellerica*, and sandalwood (*Santalum album*) are also frequent. The understorey consists of *Pavetta thompsonii, Mundulea suberosa* and several herbaceous species including *Crotolaria* spp.

A portion of the study area has been planted with teak. In the last few years however, little effort has been made to perform silvicultural operations here, in line with sanctuary management practices, and a fair amount of natural vegetation has now regenerated in these plantations. Finally, there are areas which were cleared for tapioca cultivation a few years ago, and then abandoned after being planted with economically useful species. This common but destructive practice, known as *kumri* cultivation, has resulted in large patches becoming grasslands. Some of these patches, into which macaque groups enter to forage for insects, are now maintained as grassland by regular burning, to improve herbivore pasture. Other areas subject to *kumri* cultivation are now covered with low, dense, thorny scrub consisting largely of *Dichrostachys cinerea, Mundulea suberosa, Salmalia malabarica, Ailanthus excelsa, Albizzia lebbeck* and *Chloroxylon swietenia.* These were still fairly small when the study was begun.

One of the most important genera of plants for the macaques is *Ficus*. Many species are found in this area. *F. bengalensis* is found both by the river, and away from it, but is not common. *F. retusa* is very common by the riverside. *F. talboti* is rare, but heavily used when in fruit. A few *Ficus glomerata* and *F. mysorensis* also occur on the river banks.

Climbers and twiners are abundant. The most common among these is *Zizyphus oenoplia, Combretum decandrum* and *Ventilago maderaspatensis* also occur. Even though herbs and lower ground flora were not enumerated, two deserve mention: *Lantana aculeata* and *Eupatorium odoratum* both occurred. *Lantana* was found by the riverside, and *Euptatorium* had begun invading those areas which had been recently cleared. A species-area curve (Fig. 1) for all vegetation over 3 m high shows the high diversity of the flora in a very limited area at this location.

Besides the plantations, another major habitat modification has occured. The construction of the Thambraparni Upper Dam in 1943, upstream on the Thambraparni, appears to have caused a major change in soil hydrology on the whole Mundanthurai Plateau. Forest records indicate that the vegetation has changed to a drier type than before, with species like *Pterocarpus marsupium*, which were once abundant, having all but disappeared in the study area.

The construction of the dam has had another consequence: since the waterflow in the stream is now controlled for irrigation purposes, the maximum flow in the river is at the driest times of the year. This has resulted in an obvious change in plant phenology. An

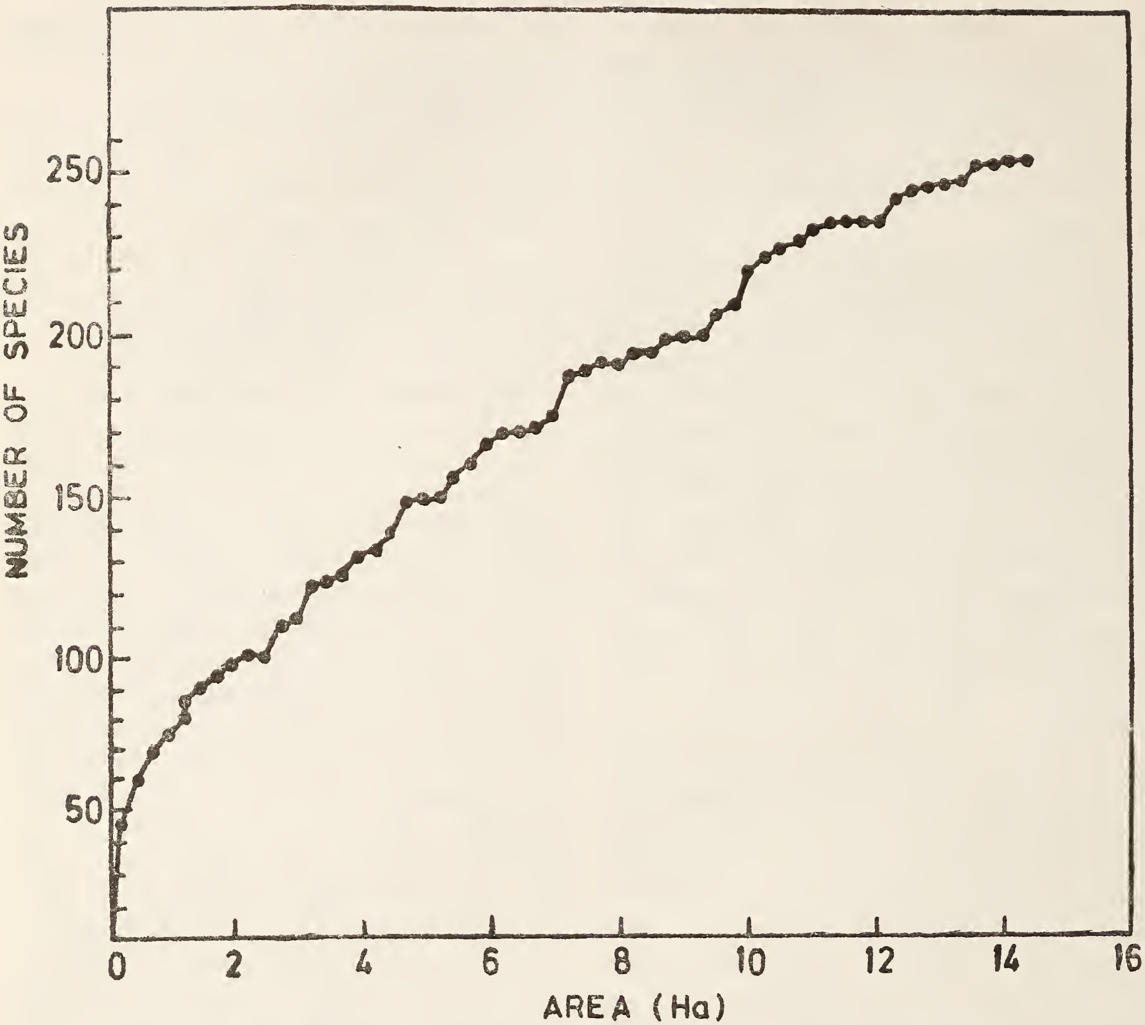

Fig. 1. Species area curve for vegetation over 3 m in height. (N.B. — Some quadrants contain patches of water as well).

example is that the flowering of *Glycosmis pentaphylla* along the Thambraparni and Servalar rivers differs by as much as a month. Also, since the river acts as a barrier to the movements of certain animals, the accessibility of certain areas to certain species of animals is arbitrarily determined, rather than being seasonal.

In spite of these disturbances, there is an impressive population of mammals found in the area. Among the predators, Leopard (*Panthera pardus*) and Wild Dog (*Cuon alpinus*) were frequently encountered. Tiger (*Panthera tigris*) was seen twice within the area, as was the Jungle Cat (*Felis chaus*). The most common ungulates were the Chital

(*Axis axis*) and the Sambar (*Cervus unicolor*). A high density of mouse deer (*Tragulus meminna*) was also found, along with wild pig (*Sus scrofa*). Elephants were normally found higher up in the hills, though in one instance an injured tusker spent a few weeks at the edge of the study area.

Among the arboreal mammals, the Malabar Giant Squirrel (*Ratufa indica*) was common. Nilgiri Langur (*Presbytis johnii*) was found in the study area, though at much lower densities than in the *Sholas* higher up. The population of Nilgiri Langurs displayed several curious characteristics, such as a sex ratio highly skewed in favour of males, and female transfers [see Ali *et al.*, (1985) for details]. They were replaced by common langur (*Presbytis entellus*) about 1 km downstream from the study area. Slender Loris (*Loris tardigradus*) was also abundant in the area.

Over a hundred species of birds were recorded from this area. Possible predators of the bonnet macaque included the Crested Serpent Eagle (*Spilornis cheela*) and the Black Eagle (*Ictinaetus malayensis*). The appearance of either caused the macaques to alarm-call and seek cover in the ground vegetation. The Wryneck (*Jynx torquilla*) and Orange-headed Ground Thrush (*Zoothera citrina cyanotus*) have also seldom been recorded from so far south in the peninsula. Shikra (*Accipiter badius*) regularly associated themselves with macaque groups, and were seen feeding on insects disturbed by macaque movements.

To complete the profile of the fauna in the area the larger reptiles included the Python (*Python molurus*), King Cobra (*Naja hannah*), Cobra (*Naja naja*), Ratsnake (*Ptyas mucosus*) and Monitor Lizard (*Varanus bengalensis*). Mugger (*Crocodylus palustris*) were wiped out several years ago, but have recently been reintroduced.

METHODS

A group of bonnet macaques was followed, from early morning till the time the group had gone to sleep. Sampling was carried out in a fashion similar to Oates (1978), Kuruvilla (1976), Green and Minkowski (1977) and Struhsaker (1975) with sampling periods of 5 minutes, followed by a 'rest' interval of 10 minutes. There were 4 samples taken each hour, and initially 5 animals were sampled in each. Later, as the group habituated the number was increased to 8. After an animal was sighted, five seconds were allowed to lapse before its activity was noted. This was to eliminate any possible bias due to the animal being sampled performing an activity that made it conspicuous. When an animal was scored as feeding, the food and item were noted, as well as the height of the animal sampled and the height of the tree it was on. Kani (local tribal) names were used initially, until the plant was identified. These names proved to be completely consistent.

PLANT SPECIES EATEN

A list of plant species eaten is given in Table 1. There were 68 plant species that were recorded as being fed upon, and the plant part eaten is given in each case. The great majority of these were only eaten occasionally. A separate list gives the top 24 food species. These accounted for over 92 per cent of all feeding. The relative rank in the month of maximum use is given, as well as the month (Table 2).

The most heavily used plant was the tama-

TABLE 1

LIST OF PLANT SPECIES EATEN BY THE STUDY GROUP (IN ORDER FIRST SEEN FED UPON)

THE NAMES USED ARE FROM GAMBLE & FISCHER (1967)

	Species	Tribal name	Type	Part Eaten
1.	*Tectona grandis*	Thekku	Large Tree	BK
2.	*Syzygium lineare*	Vinji	Small Tree	LBU
3.	*Syzygium cumini*	Navat	Large Tree	FR, LGA, FLB, BK
4.	*Mangifera indica*	Ma	Large Tree	BK
5.	*Ficus retusa*	Ala	Medium-sized Tree	FR
6.	*Ficus bengalensis*	Ala	Tree	FR, BK
7.	*Combretum decandrum*	Maduravelli/ Kidavelli	Liana/ Climber	FR, ML, LGA, TEN, YL, B
8.	*Dendrocalamus strictus*	Mungil	Bamboo	YLP
9.	*Tamarindus indicus*	Puli	Tree	FR, ML, YL
10.	*Zizyphus oenoplia*	Pulichi	Climber	FR
11.	*Memecylon edule*	Kancham	Large shrub	FR, ML
12.	*Diospyros peregrina*	Palinji	Small tree	FR, BK
13.	*Diospyros montana*	Vakkanai	Tree	FR, YL, ML, FRB
14.	*Albizzia lebbeck*	Vahai	Tree	BK, FLB
15.	*Pongamia glabra*	Pung	Tree	
16.	*Azadirachta indica*	Vembu	Small tree	ML, BK
17.	Unid. sp. 1	Mututengu	Large shrub	ML, FR, FL
18.	*Ficus glomerata*	Atthi	Tree	FR
19.	*Pandanus tectorius*	Thani	Shrub	FR, PTH
20.	*Lantana aculeata*	—	Sorambler	ML, FR
21.	*Ficus talboti*	Atthi	Tree	FR
22.	*Pavetta thomsonii*	Pavattai	Shrub	FR, FLB, FL
23.	*Mitrephora heyneana*	Nedunarai	Tree	FR
24.	*Orophoea thomsonii*	Nedunarai	Shrub	FR, FLB
25.	*Alphonsea sclerocarpa*	Nedunarai	Tree	FR, YL, FRB
26.	*Mesua ferrea*	Nangu	Large tree	FL
27.	*Randia malabarica*	Mulli	Shrub	FR
28.	*Glycosmis pentaphylla*	Manthai	Small shrub	FR
29.	*Phyllanthus polyphyllus*	Katnelli	Small tree	FR, FRB
30.	*Carissa opaca*	Klaka	Shrub	FR, FRB
31.	Unid. sp. 2	Erukalai	Small tree	
32.	*Clerodendrum infortunatum*	—	Small tree	
33.	*Aglaia roxburghiana*	Chokla	Small tree	FR, FL
34.	*Erythroxylum monogynum*	Chenpuna	Shrub	FR
35.	*Mothopegia beddomei*	Charamaram	Small tree	FR
36.	*Grewia tiliaefolia*	Velle-Unnu	Small tree	FR
37.	*Grewia orientalis*	Kar-unnu	Small tree	FR
38.	*Calophyllum elatum*	Toraipanna	Large tree	FL

TABLE 1

Species	Tribal name	Type	Part eaten
39. *Terminalia bellerica*	Tani	Large tree	FR
40. *Randia dumetorum*	Karai	Shrub	FR, ML
41. *Maba buxifolia*	Karun thovarai	Small tree	FR
42. *Cassia fistula*	Konnai	Large Tree	?
43. Lauraceae sp. 1	Kanjiramkodi	Climber	FR
44. Unid. sp. 3	Chennelli	Shrub	FR
45. *Santalum album*	Sandana	Small Tree	FR
46. *Limonia alata*	Katnaru	Large shrub	FRB, FR, BK
47. *Helecteres isora*	Kasuva	Rambling shrub	FL
48. Cucurbitaceae sp. 1	Chadavelli	Twiner	ML
49. *Bauhinia longifolia*	Arampuli	Small Tree	FRB
50. *Mundulea suberosa*	Pul-avarai	Shrub	?
51. Unit. sp. 4	Katvelli	Twiner	ML
52. *Buettneria* sp.	Kasuva	Climber	FR, FL
53. *Acacia caesia*	Korung-senjai	Climber	?
54. *Manihot utilissima*	Tapioca	Herb	RT
55. Unid. sp. 5	Kutapra	Shrub	FL
56. *Hugonia mystax*	Manjakodi	Climber	FR
57. *Eupatorium odoratum*	Poga-elai kodi	Herb	ML
58. *Bauhinia racemosa*	Arampuli	Small Tree	FR
59. *Ficus mysorensis*	Kat Atthi	Tree	FR
60. *Dalbergia paniculata*	Adukuvahai	Tree	FRB
61. *Celastrus paniculata*	Vembaladan	Climber	YL
62. *Vitex leucoxylon*	Nirvitti	Tree	YL
63. *Flacourtia* sp.	Kathikarai	Shrub	?
64. *Crotolaria* sp.	—	Herb	?
65. Unid. sp. 6	Mulli	Shrub	?
66. *Toddalia asiatica*	Mulli	Rambling shrub	FR
67. *Albizzia amara*	Usil	Small Tree	BK
68. *Atalantia monophylla*	Kat-elumichai	Shrub	FR, BK, ML

KEY TO ABBREVIATIONS

LBU — Leaf bud; ML — Mature leaf; YL — Young leaf; YLP/SHT — Young leaf patiole; BK — Bank; FR — Fruit; FRB — Fruit bud; FL — Flower; FLB — Flower Bud; RT — Root; TEN — Tendril; LGA — Leaf gall; PTH — Pith; ? — Part Unidentified.

TABLE 2

THE TOP 24 FOOD PLANT TAXA UTILISED BY THE STUDY GROUP

	Species	Total % in diet	% Eaten monthly maximum	Rank in month	No. months eaten*
1.	*Tamarindus indicus*	21.25	26.9 (Jan. '78)	1	10
2.	(Insects)	13.37	28.8 (Oct. '77)	1	14
3.	*Ficus retusa*	12.76	53.6 (Mar. '78)	1	9
4.	*Dendrocalamus strictus*	5.95	22.0 (Oct. '77)	2	12
5.	*Ficus talboti*	5.37	39.4 (Apr. '78)	1	4
6.	*Zizyphus oenoplia*	5.33	27.9 (Apr. '77)	1	4
7.	Grasses spp.	3.83	11.2 (Dec. '77)	2	12
8.	*Syzygium cumini*	3.10	29.3 (Feb. '77)	1	10
9.	*Memecylon edule*	2.88	8.78 (Nov. '77)	3	9
10.	*Diospyros montana*	2.54	19.6 (Jun. '77)	1	6
11.	(Assorted herbs)	2.11	4.2 (Jun. '77)	4	11
12.	*Santalum album*	2.02	9.3 (Feb. '78)	4	6
13.	*Randia malabarica*	1.78	6.8 (Nov. '77)	4	6
14.	*Alphonsea sclerocarpa*	1.44	11.5 (Nov. '77)	2	4
15.	*Ficus bengalensis*	1.34	12.5 (May '77)	1	5
16.	*Orophoea thomsoni*	1.15	33.3 (Feb. '79)	1	3
17.	Tiliaceae sp. 1	1.06	3.8 (Mar. '78)	4	4
18.	*Phyllanthus polyphyllus*	0.96	6.1 (Nov. '77)	5	5
19.	*Glycosmis pentaphylla*	0.91	6.8 (Oct. '77)	3	4
20.	Mushrooms/fungi)	0.91	2.9 (Jan. '78)	4	5
21.	*Lantana* sp.	0.76	3.8 (Apr. '78)	4	5
22.	*Combretum decandrum*	0.76	3.4 (Oct. '77)	4	8
23.	*Pandanus tectorius*	0.52	5.1 (Sep. '77)	5	3
24.	*Diospyros peregrina*	0.52	2.2 (Sep. '77)	6	6
		92.02%			

* Max: 14 months.

rind (*Tamarindus indicus*). Normally both the ripe and unripe fruits were eaten, though young leaves accounted for a majority of the feeding observations made on this species in June 1977, when it was the second most heavily used food item.

An interesting aspect about tamarind use is that it must be a comparatively recent phenomenon. Tamarind was introduced from East Africa about 500 years ago (Gamble and Fischer 1967). It now grows wild over a considerable area but is seldom found at high densities at any given place. Its intensive use by macaques is a pointer to their adaptability. The presence of tannins in the unripe fruit, which is indicated by the astringent taste, does not seem to inhibit feeding on it even slightly.

Of the five *Ficus* species in the area, three: *F. talboti*, *F. bengalensis* and *F. retusa* formed a major component of feeding, with the ripe fruit being eaten. In March and April

1978, two trees — one of *F. retusa* and one of *F. talboti* — alone accounted for over 40 per cent of all feeding records. *Ficus* form the major food of a number of primate species (Hrdy 1979) and there is a suggestion that a degree of co-evolution has occurred between monkeys and figs (Mackinnon, *pers. comm.*): a hypothesis which remains untested at the moment. Figs provide a major source of protein because of the wasps that are resident within them. Interestingly, one of the species not eaten by the macaques — *Ficus glomerata* — has waterborne seed dispersal. The three that are eaten fruit in a short time span once a year, and attract a large number of animal and bird species at this time — including, apart from the monkeys, giant squirrels and palm squirrels, as well as koels, green barbets and malkohas.

Bamboos also form a major food item of the two species found in the study area, *Bambusa bambos* had just flowered and consequently, was unavailable as a food. Several clumps of *Dendrocalamus strictus* were found in the study area, and the monkeys fed by pulling off the young leaves from their sheaths and nibbling off the petiole. This was the only part of the plant that was eaten.

The ripe fruit of *Zizyphus oenoplia* was available between February and April. It ranked among the top 5 food items in these months. In February 1979, feeding on this was not observed and field protocols indicate that the fruit was unripe at this time.

Among the other foods available, Sugiyama (1971) records *Syzygium cumini* as being a major food item of the bonnet macaque. However, in this area, this species was ranked only 8th overall. The maximum number of feeding records on it did not consist of fruit, but of leaf-galls, which are another potentially good protein source for the macaques.

Of the *Diospyros* species in the area, *D. montana* fruits were eaten whenever available, even when unripe. However, *D. peregrina* fruits, which were regularly eaten by groups of liontailed macaques in the vicinity, were seldom touched. Seed dispersal in this species is by means of water, and ripe fruit were often seen floating down the river. The mesocarp is very resinous, and this could be one reason why it was not eaten. The majority of feeding observations on this were made on one old male. He would pluck the fruit, walk down to the river with it, and wash it in between bites. I tried this and found that washing the fruit reduced the amount of resin in the mesocarp, rendering it more palatable. However, none of the other animals in the group seemed to have developed this habit.

Herbs and grasses also formed a substantial part of the diet, together with certain mushrooms when available. Insects ranked among the top 5 food items each month, forming up to 30 per cent of the diet in each month. These included various species of crickets, cicadas and termites; caterpillars were also eaten. Animals would stalk crickets, and there seems to be a difference in the number of successful captures among the animals in the group.

On one occasion, the group was seen outside a swarming termite mound, grabbing termites both from the air, and picking them up from the ground. Termites caught flying would be held by the wings. The body would then be bitten off and the wings discarded. A calculation based on feeding rates and the amount of time each animal fed shows that within 150 minutes, over 22,000 termites were eaten by the 16 animals in the group!

A breakdown of the various food items

eaten is given in Table 3. The amount of insect-eating decreases when fruit-eating increases. The extent to which both contain the same constituents awaits a detailed nutritional analysis.

A diversity index, H' was used to test for the variety of food items in each month. The more items that are used, the higher the diversity index, and the more equally they are used, the higher the value of the index, also. H' is derived by using the following formula

$$H' = \Sigma\ p_i \ln p_i$$

where Pi is the proportion of the i-th item in the diet & log is the natural logarithm. This is summed for all food items eaten: in this case, *n* food items. Correlations using the diversity of food items shows that as the proportion of fruit in the diet increases, the diversity of feeding: in this case the evenness — on all other items also increases ($r_s = 0.7$, $p < 0.01$). (Fig. 2).

VARIATIONS BETWEEN AGE-SEX CLASSES AND OVER TIME

There is significant variation in the amount of time spent feeding, both between age-sex classes, and between months. The maximum any age-sex class was recorded feeding was for subadult males, who spent 28 per cent of their time feeding in February 1977. Minimum feeding was also recorded for subadult males, who fed for only 8.7 per cent of their time feeding in February 1979. This was after a cyclone, in November 1978, when both adult males disappeared. The subadult males had risen in the dominance hierarchy, and group ranging patterns had changed substantially at this time.

In general, feeding varied between 15-25 per cent of total activity for all animals, in each month (Fig. 3). Adult males, on average, spent the least amount of time feeding. Subadult males spent the most, followed closely by the subadult females, with juveniles feeding less than both. Between months, the maximum time spent feeding was recorded in October 1977, and the minimum in May 1977. These differences are significant ($F_{12,36} = 3.39$, $p < 0.01$).

Feeding patterns also vary over the day. For analysis days were divided into 3 blocks from 6-10 a.m. (morning), 10 a.m.-2 p.m. (noon) and 2 p.m.-6 p.m. (afternoon). Different amounts of time are spent feeding in each period ($\chi^2 = 43.57$ with 2 d.f., $p < 0.01$), with more feeding than expected in the evening, and less than expected in the noon period. More interestingly, variations in the items eaten over the day were also noted, with significantly more fruit being eaten in the mornings ($\chi^2 = 25.62$ with 2 d.f., $p < 0.005$) and more bamboo being eaten in the afternoons ($\chi^2 = 73.43$ with 2 d.f., $p < 0.005$). However, the intake of insects remains fairly constant over the day ($\chi^2 = 1.56$, n.s.) as does the intake of foliage.

The increased intake of bamboo in the afternoons leads one to speculate that bamboo leaf-petioles may be eaten as a 'filler' if the group has not fed sufficiently during the day. An alternative explanation is that bamboo clumps coincidentally happen to be near sleeping sites, resulting in their use in the evenings. Several attempted correlations, however, failed to distinguish between these two hypotheses.

POSTSCRIPT

Approaches such as the one given above show clearly the pitfalls in a qualitative approach. It is useful to refer to Prasad *et al.* (1978) attempts to explain the factors govern-

TABLE 3

THE PERCENTAGE OF EACH ITEM IN THE DIET DURING EACH MONTH, AND FEEDING DIVERSITY

UND — Undetermined; INS — Insect; FR — Fruit; FRB — Fruit bud; ML — Mature leaf, YL — Young leaf; YLP — Young leaf petiole; LGA — Leaf galls, BOO — Bamboo, RT — Root, FL — Flower bud, BAR — Bark, SD — Seed, MUSH – Mushrooms.

	UND	INS	FR	FRB	ML	YL	YLP	LGA	BOO	RT	FL	FLB	BAR	SD	MUSH	Sample Size (N)	Diversity (H)
Feb. 1977 %	40.8	6.4	22.9	0.6	0.6	—	—	1.3	0.6	—	—	26.8	—	—	—	157	1.19
Apr. 1977	37.5	6.25	48.6	—	1.4	2.1	—	—	1.4	—	—	—	2.8	—	—	144	0.849
May 1977	49.0	4.9	41.2	—	—	—	—	—	—	—	1.0	1.0	2.9	—	—	102	0.714
Jun. 1977	14.9	10.6	36.7	—	10.1	17.0	0.5	—	1.6	—	3.7	1.1	2.1	1.6	—	188	1.66
Aug. 1977	16.7	34.5	27.4	—	—	7.1	—	—	3.6	1.2	1.2	1.2	3.6	2.4	1.2	84	1.558
Sep. 1977	11.8	10.7	37.1	1.1	5.1	1.1	—	—	22.4	—	0.6	0.6	9.6	—	—	178	1.552
Oct. 1977	13.6	28.6	19.9	—	3.9	2.4	—	1.5	24.8	—	0.5	1.0	1.9	—	1.9	206	1.621
Nov. 1977	17.6	4.2	63.4	—	5.6	—	—	—	4.9	—	0.7	0.7	0.7	0.7	1.4	142	0.935
Dec. 1977	10.1	5.8	62.9	1.1	3.6	—	—	0.7	4.3	—	9.4	—	0.7	—	1.4	278	1.131
Jan. 1978	14.5	9.8	62.5	0.4	3.3	0.4	—	—	2.2	—	0.7	1.8	1.5	—	2.9	275	1.054
Feb. 1978	3.3	9.3	78.9	0.7	1.9	—	—	—	3.0	0.4	1.5	—	1.1	—	—	270	0.75
Mar. 1978	3.8	5.8	84.6	1.7	1.4	1.0	—	—	0.3	—	0.7	—	0.7	—	—	293	0.552
Apr. 1978	21.2	8.9	52.5	2.1	3.4	1.7	—	—	5.1	0.8	—	1.3	3.0	—	—	236	1.248
Feb. 1979	6.6	24.6	45.9	4.9	—	3.3	—	—	3.3	4.9	6.6	—	—	—	—	61	1.433
Total (Means)	16.3	10.6	53.4	0.8	3.2	2.2	0.04	0.3	5.7	0.3	1.9	2.2	2.1	0.23	0.73		

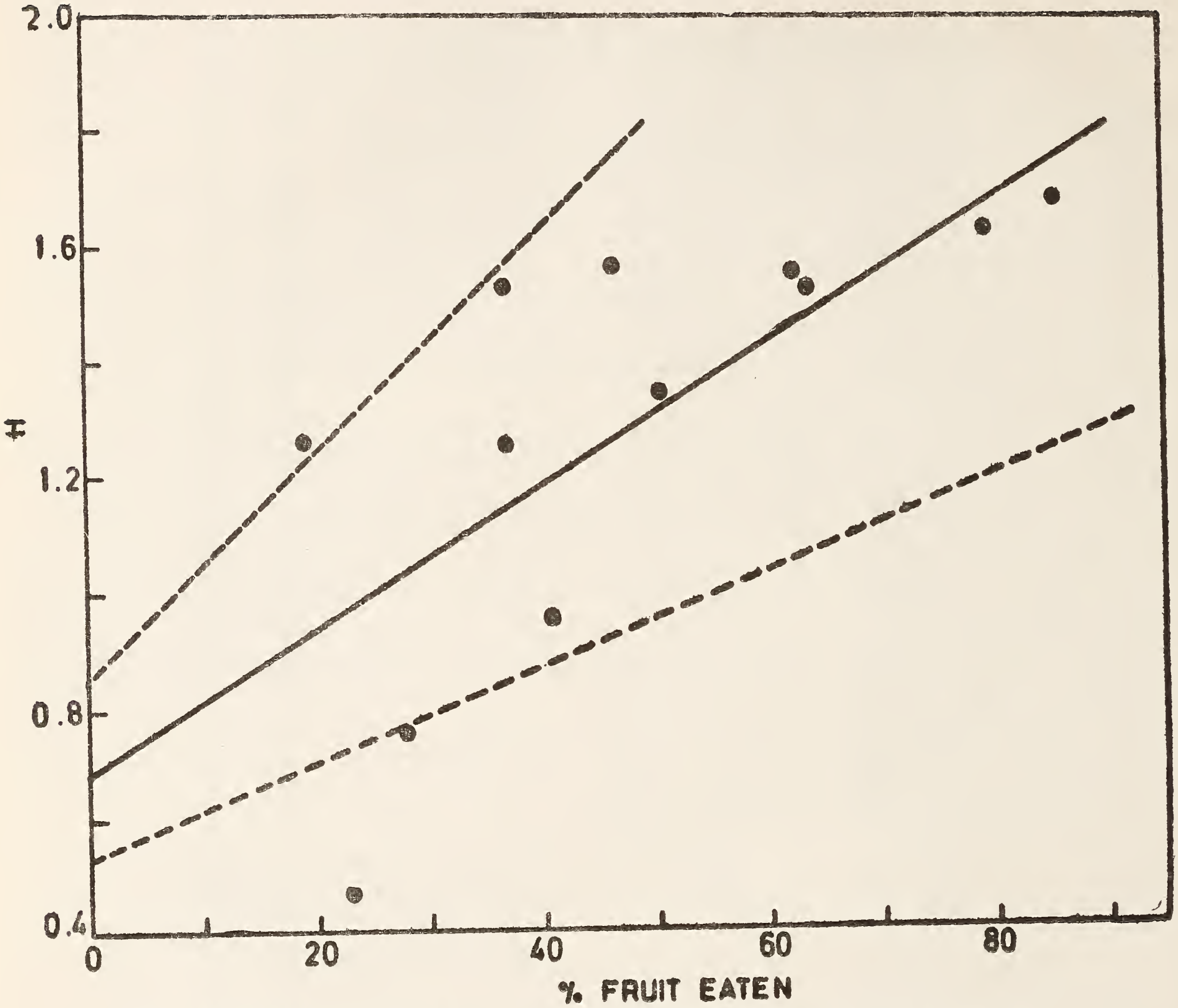

Fig. 2. Evenness of feeding on other food items as proportion of fruit in diet increases.

ing the distribution of mammals in Karnataka. Reference to the relevant data for bonnet macaques (p. 737, Table 2), and the foregoing detailed figures show how inaccurate the original figures were. Grass and tree leaves are certainly not absent from the diet. Eating of seeds is rare, and not common. For the rest, it is difficult to arrive at any kind of qualitative distinction between 'common' and 'abundant'. Does one average it over the year or take any one month, how does differential sampling of age-sex classes affect the results, and how does one account for group size affecting what is eaten — all factors that are likely to play important roles?

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The field work of which this paper forms a

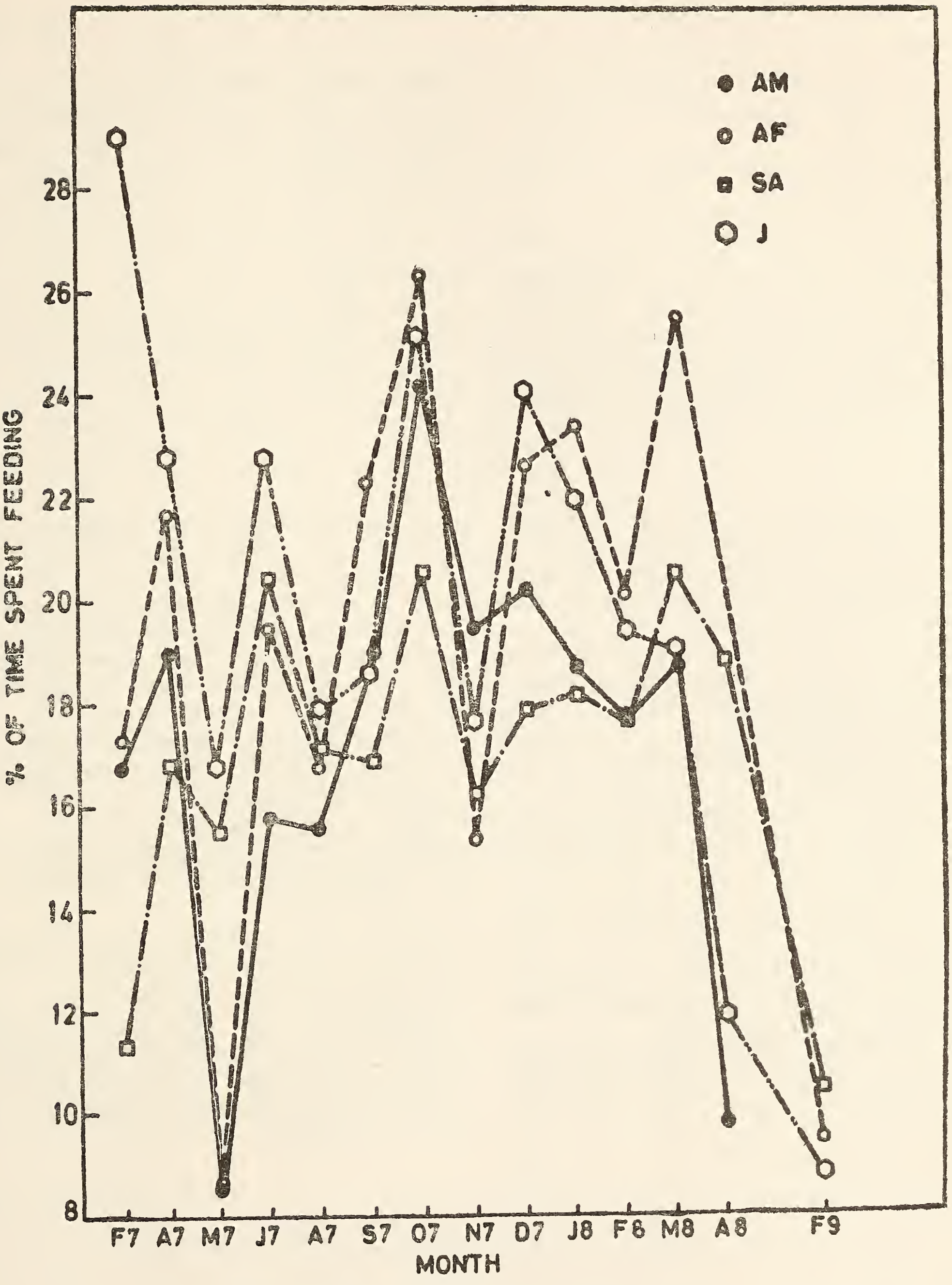

Fig. 3. Monthly feeding by each age-sex class.
N.B.: AM—Adult male; AF—Adult female; SA—Subadult male; J—Juvenile.

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THE INDIAN CHAMELEON, *CHAMAELEON ZEYLANICUS* (LAURENTI) IN SATKOSHIA GORGE SANCTUARY, ORISSA: NOTES ON AVAILABILITY, GROWTH AND BIOMETRICS[1]

L. A. K. Singh[2]

(*With three text-figures*)

Between September 1975 and August 1980, 113 chameleons were obtained from local people (accidental captures) within a 5-km radius of Tikerpada in Satkoshia Gorge Sanctuary. Marking by toe-clipping is believed to have shortened the life span when 96 chameleons were returned back to the wild. Based on capture record that indicated a gradual decline in the juvenile and adult population it is believed that the adults are distributed in the study area in a very low density may be 1-2 animals per sq. km. Low density of distribution supports an observed sex ratio of 1 female: 2.46 male; since males wander more, are less territorial and a larger number of males offers a selective advantage in producing offsprings sired by a better male. Availability of chameleons depended on food- availability. More number of animals were obtained after each seasonal rain in monsoon, winter and summer. Procryptic behaviour in young ones were more pronounced. The rate of growth in the wild is estimated to be about 11 mm (average SV) per month during the first year. The 33 mm (SV) long hatchlings approach adult-hood at about 155 mm at the end of the first year. The average maximum size was about 180 mm and animals above 200 mm and beyond second year were rare. For SV lengths of 100, 150 and 200 mm respectively the TBL were 216, 324 and 432 mm, HC were 32, 46 and 60 mm, and W 16, 53 and 125 g. The hatchlings weighed 0.9 g. Variations from a straight-line relationship between SV and HC are suggested as variations in the size of the casque on the head. The casque is used in female to assist in nest-digging and suspected to be an organ of advertisement for courting males.

INTRODUCTION

The present paper reports preliminary observations made on variable availability, growth rate, biometrical relationships and the probable life-span of the Indian chameleon, *Chamaeleon zeylanicus.* The information recorded for the present paper were made possible during my stay in the Satkoshia Gorge Sanctuary, Orissa in connection with the Crocodilian Conservation Programme. It is believed to form a valuable adjunct to another paper (Singh *et al.* 1984) that reported on observations on the reproductive biology of the species as observed in the wild and captivity, also in Orissa. Hitherto the knowledge on *C. zeylanicus* have remained limited to range-distribution notes by Boulenger (1890), Parshad (1914), Smith (1935) and Deraniyagala (1953), and

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preliminary observations on the reproductive biology by Trench (1912), Biswas and Acharjyo (1977) and Whitaker (1978). A recent compilation on the species (Daniel 1983) had evidently relied mostly on the author's (Daniel, J. C.) own experience and Trench (1912) and Whitaker (1978).

MATERIALS AND METHODS

The observations were recorded between September 1975 and August 1980 at Tikerpada in the Satkoshia Gorge Sanctuary located in Central Orissa (84°47′E/20°35′N). Materials for the study were obtained from two sources — from nature and from young ones hatched in captivity from eggs laid at the Gharial Research and Conservation Unit (GRACU), Tikerpada. During the period of five years 113 individuals from nature were mostly (accidentally) caught by local people and sold to me at a nominal rate of Rs. 2 to 3 per animal. All animals were procured from an area spread over a radius of 5 km on the northern side of River Mahanadi — a hilly tract of moist deciduous forest, hills ranging upto 700 m in height. The chameleons were caught during the day, except a lone nesting female, from public or private roads and rarely from the inside forest, and no special effort was made to conduct a systematic capture operation.

Out of 113 wild chameleons received at GRACU 96 were returned back to the wild soon after marking by toe-clipping. Normally all wild chameleons had reached GRACU on the day of capture. The following information on each chameleon were recorded against the date of its arrival at GRACU: total body length (TBL), Snout-Vent length (SV) and the body weight (W). In some instances the tails were missing from the live animal — a result of the belief regarding its use in talismans curing infantile convulsion (Singh 1979). For 76 individuals the lengths of head and casque (HC) were also recorded, and at a later stage during the study sexes were recorded for 45 animals.

The information recorded for wild chameleons were used to determine the variation in their availability during different years and months, and for different size classes. The wild growth rates were studied indirectly from the sizes available in a calendar month taking due consideration of the phenomenon of variable growth rate in the same brood (Singh 1978) as seen in other reptiles. The relationships between TBL-SV, SV-HC and SV-W were determined from the biometrical data. These studies later were supported with information on captive-hatched chameleons.

The study years were considered from September through August (Fig. 1a, c) and monthwise availability were considered with the hatching-month June (Singh *et al.* 1984) (Fig. 1 b).

For analysing the number of chameleons available according to their sizes (SV), the animals were grouped under eleven groups, each group considering 15 mm of SV. The first group was 45-59 mm SV and the last 195-209 mm.

SV lengths of chameleons were plotted against their date (fortnight) of arrival in Fig. 2. This was used to determine the growth rate in the wild.

Relationship of TBL, HC and W with SV were determined by plotting the points against SV on a graph sheet (Fig. 3 a and b). By visual estimation mean lines representing the relationships were plotted on the graph. From the latter mean TBL, HC and W were determined for standard SV values.

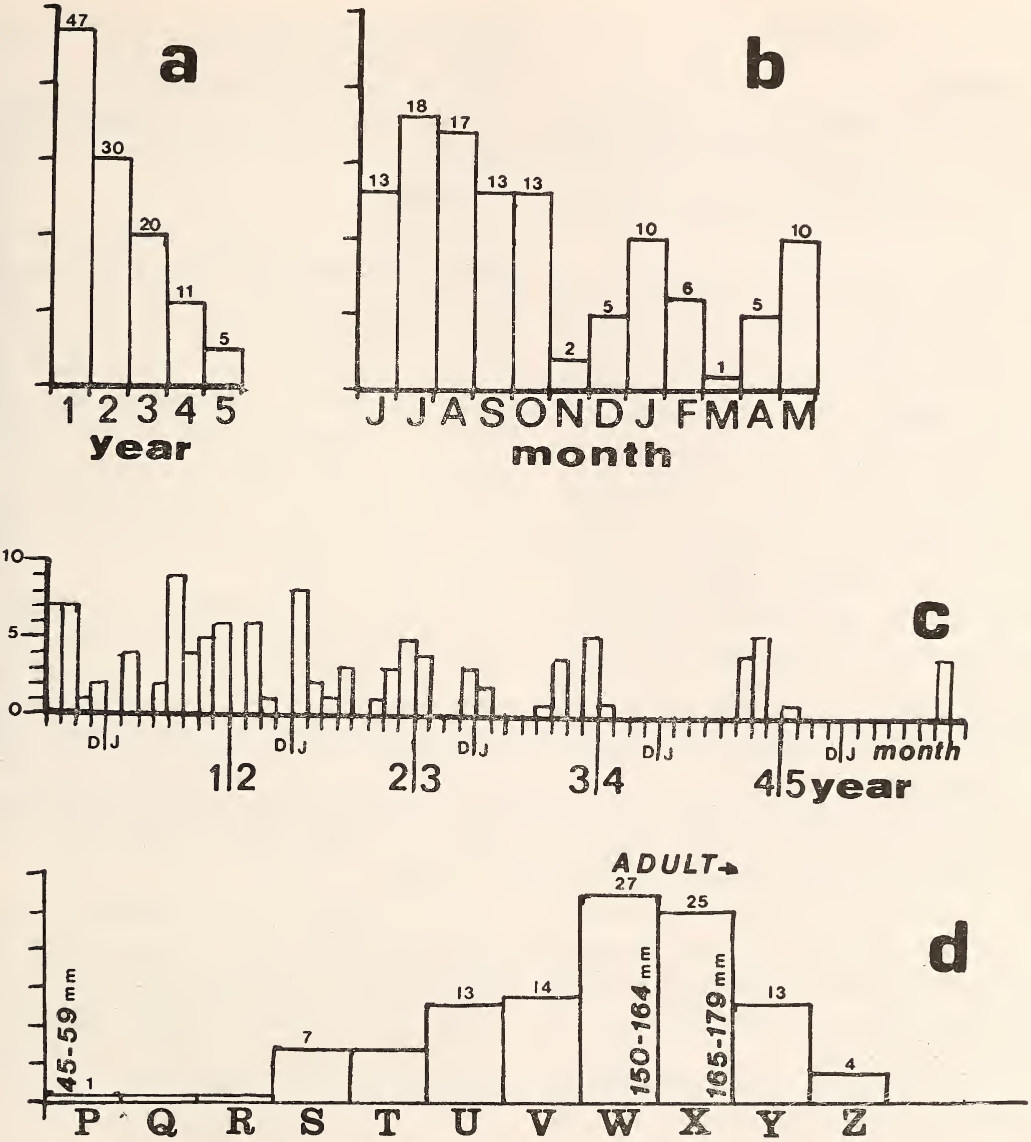

Fig. 1. Number of chameleons obtained during the study:

a. per year (September through August) for the 5-year study period (1 through 5).
b. per month (cumulative data for 5 years) from June (J), the month of egg-hatching,
c. per individual month throughout the 5-year period — D, December; J, January; 1 through 5, years of study as in Fig. 1 a,
d. per 15 mm (SV) size groups (P through Z).

RESULTS

1. **Availability:**

The number of chameleons caught during the first year (September 1975-August 1976) was 47. The number decreased to 30, 20, 11 and 5 during the second through the fifth year (Fig. 1a).

The highest number of chameleons were available during May (1st year), January (2nd year), August (3rd year) and July (4th and 5th years). The next high number of chameleons were obtained during September (1st year, 3rd year and 5th year), October (1st and 2nd year), and June (3rd and 4th year). During the 1st year no chameleon was obtained, during January and March. In the 2nd year there was no collection during September, December and May, and collections during the 3rd year were only in September, December, January, May, June and August. During the 4th year collections were in September, June and July, and during the 5th year collections were in September and July (Fig. 1 c).

As shown in (Fig. 1 b), the highest number of chameleons were obtained during July and August, 15.9% and 15.0% of the total. These numbers were followed during the months of June, September and October, each recording 11.5% of the availability. The lowest numbers were obtained during February (5.3%) and November (1.7%).

Out of 45 cases where sexes were definitely known and recorded, 32 were males and 13 females. The likelihood was that some females were confused with immatures and were not assigned to any sex group.

With the increase in size-groups there was a gradual increase in the number of chameleons that were available up to 150-164 mm SV. This was followed by a gradual decrease in the number for the three groups that followed the highest-represented group (Fig. 1 d).

Out of the total 96 releases after marking, only one chameleon was recaught within six days. There were no other recapture records.

2. **Growth:**

On plotting the points for studying the growth rate in the wild (Fig. 2) S-line indicated the extent of fast-growth recorded for the first year, and T-line the zone for slow-growing 2nd-year chameleons. No other space was clearly demarcated to demonstrate the continuation of growth through a 3rd year or beyond. The zone between P and Q (150-160 mm SV) appeared to be the transitional sizes for averagely growing chameleons from the 1st year to the 2nd year.

Four chameleon hatchlings were measured soon after hatching in captivity: these were 71.7 mm (TBL), 33.5 mm (SV), 11 mm (HC), and 0.9 g (W). After 18 days the measurements were: 86.5 mm (TBL), 40.5 mm (SV), 12.5 mm (HC) and 1.2 g (W), and after a month and a half these were 104 mm (TBL), 50.5 mm (SV), 15 mm (HC) and 2.7 g (W).

For SV lengths 50 mm, 100 mm, 150 mm and 200 mm the TBL were respectively 108, 216, 324 and 432 mm, and HC were 18, 32, 46 and 60 mm (Fig. 3 a). Body weights were 16, 53 and 125 g for SV lengths 100, 150 and 200 mm respectively (Fig. 3 b).

DISCUSSION

1. **Availability:**

Since recapture of marked and released animals have been only 1 out of 96, it is suspected that the method of toe-clipping is not suitable with this species (*C. zeylanicuc*). It is

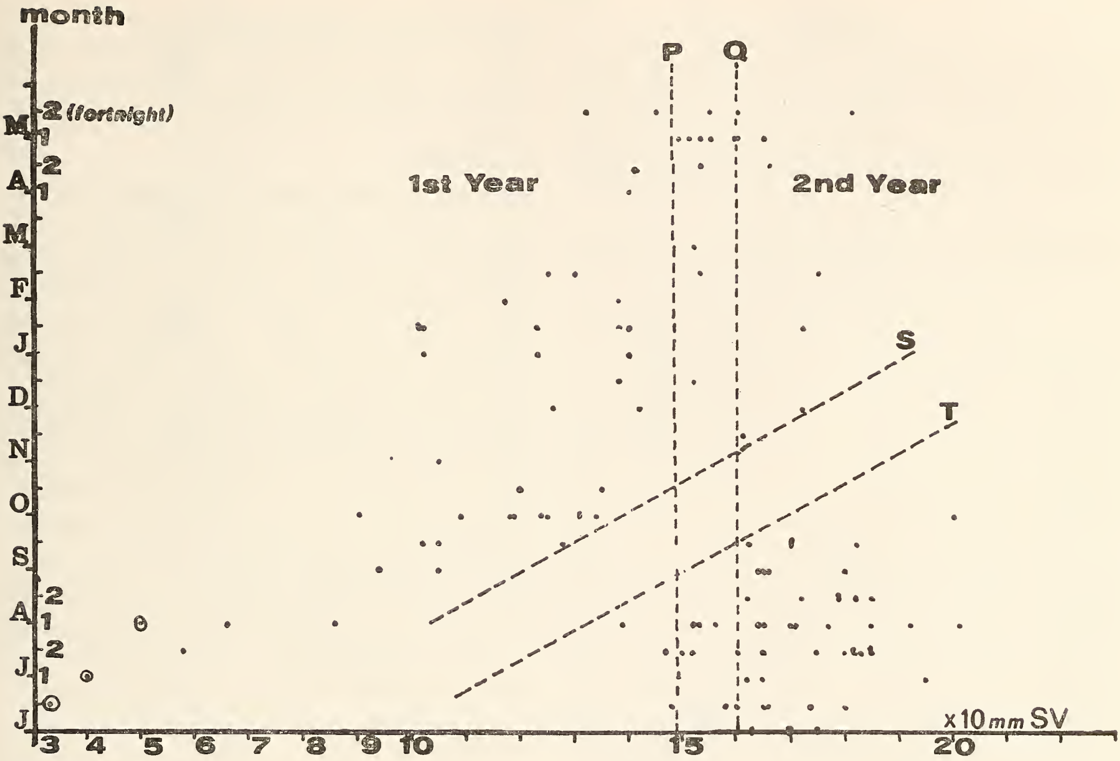

Fig. 2. Indirect record of growth of *C. zeylanicus* in the wild in Satkoshia Gorge Sanctuary. PQ, zone of transition between 1st year and 2nd year after hatching; S, limit of fast-growing 1st year forms; T, limit of slow-growing (in the present case) 2nd-year form. Each point corresponds to the size (SV) against date of arrival of a chameleon.

not possible to provide the exact nature of the effect of toe-clipping but there is indication that the marking method might have caused the death of younger chameleons and further cut-short the life of adults who in any case were in their second year of life (see below). Honegger (1979), discussing of the marking techniques for amphibians and reptiles, have also stated of the probable limitations in toe-clipping amphibians. The gradual decrease in the number of captures of chameleons from 47 in the 1st year to 5 in the 5th year (Fig. 1a), number of adults (Table 1) from 27 to 5 and juveniles from 20 to nil are indicative of a distributional density of the species in the wild. If it is assumed that none of the 'released' chameleons returned back to the population, the captures in the subsequent years are from the survivors and that there is no 'influx' of individuals from the adjacent areas, then *C. zeylanicus* is extremely solitary (Singh *et al.* 1984), and the density may be 1-2 adults per sq. km.

Low density of distribution also support the significance of a greater proportion of males in the population. In the recorded in-

TABLE 1

Chamaeleo zeylanicus IN SATKOSHIA GORGE SANCTUARY, TIKERPADA: AVAILABILITY OF DIFFERENT SIZE GROUPS (SV MM) THROUGH DIFFERENT YEARS. EACH STUDY YEAR BEGINS WITH SEPTEMBER AND ENDS WITH AUGUST. OBSERVATIONS WERE RECORDED BETWEEN 1975 AND 1980.

Size group	Years of Study					Total
	1	2	3	4	5	nos.
Juveniles:						
45-59	1	–	–	–	–	1
60-74	–	–	1	–	–	1
75-89	–	–	1	–	–	1
90-104	3	4	–	–	–	7
105-119	2	3	1	1	–	7
120-134	8	5	–	–	–	13
135-149	6	2	5	1	–	14
Sub-total	20	14	8	2	–	44
Adults:						
150-164	17	5	1	3	1	27
165-179	9	4	6	4	2	25
180-194	–	6	4	1	2	13
195-209	1	1	1	1	–	4
Sub-total	27	16	12	9	5	69
Total	47	30	20	11	5	113

stances for the present study, the female: male ratio was 1:2.46. Since males are less territorial and wander more than the females (Bustard 1965, 1966, Singh *et al.* 1984) more number of males favours a greater chance of their 'meeting' a female during the breeding season. When more than one male is available for courting the female, there is always a selective advantage to produce offspring sired by a better male.

Irrespective of the fall in yearly captures, the number of chameleons were the maximum during or after the rains in monsoon, winter and summer. The least number were collected during the driest months. Availability, depending on ground-level activity, appeared dependent on food-availability. Singh *et al.* (1984) have also mentioned that the hatching process is timed to food-availability with the beginning of monsoon.

Procryptic behaviour of chameleons have always made it difficult to study it in the wild. This behaviour may be more evident in the juveniles. With the approach of adult-hood their movements and appearances become greater, and because of their larger size these are easily detected. The above explains the reason for the gradual increase in number of chameleons that were available up to the size group 150-164 mm SV (Fig. 1 d). The size groups 150-164 mm and 164-179 mm are almost equally represented in the capture record — 23.8% and 22.1% respectively. The two size groups following these are also adults in their breeding-size but apparently such sizes are attended to less often (see below).

2. **Growth:**

The growth rates were extremely fast, for the hatchlings in the beginning. Four captive hatchlings measuring 33 mm (SV) had grown to 40 mm in 18 days and 50 mm (n=2) in 1.5 months, indicating growth of about 11 mm during the first month. At the end of the first year the average size of *C. zeylanicus* is estimated to be about 155 mm (SV) (Fig. 2) indicating a mean growth rate of 11.1 mm a month over the 33 mm size of the hatchlings. The estimated wild growth rate of 11.1 mm a month during the first year includes, obviously, a slower rate of growth during the winter when temperature and food supply are low. Therefore, the normal wild growth for early hatchlings may be much higher than 11.0 or 11.1 mm as stated above. In the present study the growh of captive hatchlings during the

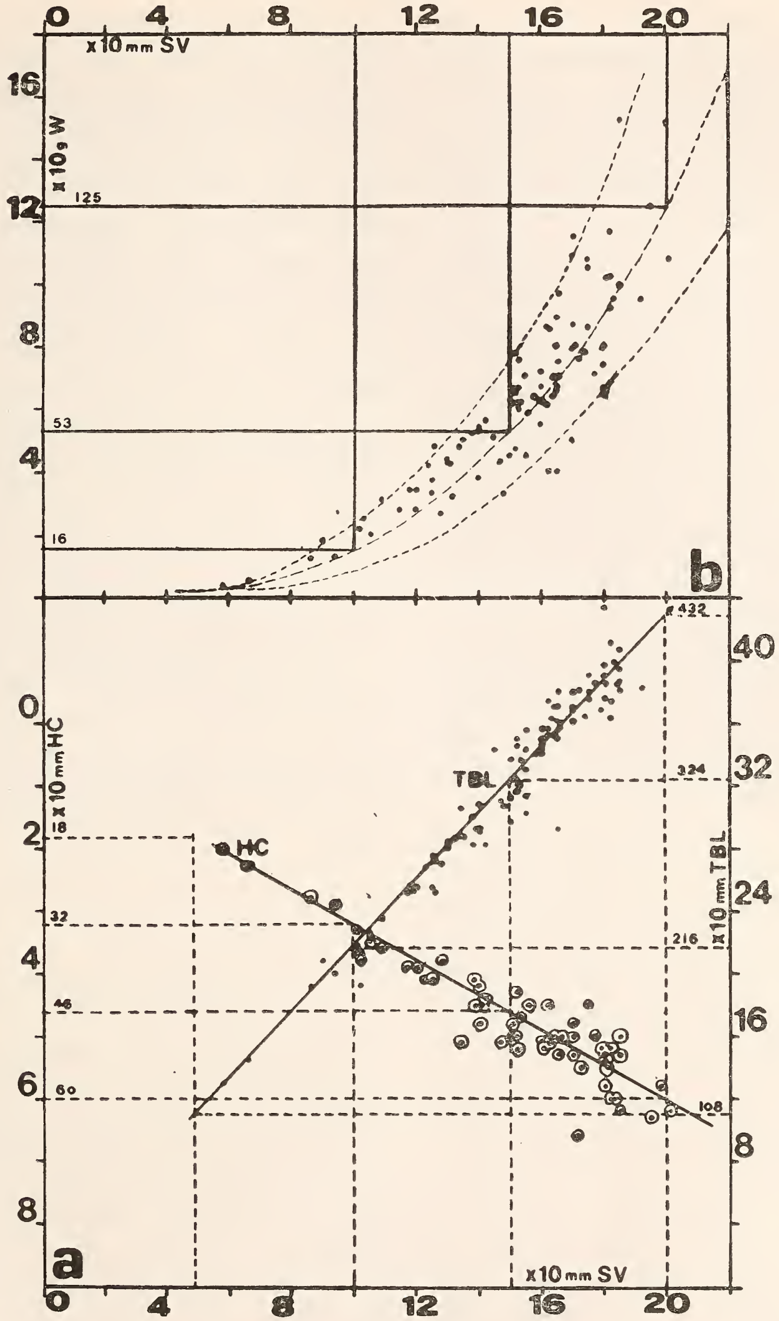

Fig. 3 a. Relationship between SV-TBL and SV-HC (see text).
b. Relationship between SV and W (see text).

first 1.5 months might have been low due to a restriction in food choice. Mentioning about *C. hohnelii,* Bustard (1965) has also recorded a fast rate of growth for the species — a specimen 48 mm long (SV) reached 53 mm in 18 days. The hatchlings are 44.0-49.7 mm in TBL and above 20 mm in SV.

The largest male and female *C. zeylanicus* recorded during the study were 201 and 195 mm (SV) respectively. The average maximum size may be about 180 mm and sizes up to and above 200 mm are perhaps not common, as seen in Fig. 1 d. The predominance of the group 150-164 mm SV is perhaps because of the commencement of the breeding activity (Fig. 1d). This size range (150-160 mm) is also the transition from the first to the second year after hatching (June).

Singh *et al.* (1984) mentioned that the female chameleons die within 1-42 days after egg laying. This may be a natural phenomenon too. From observations made in the present study (Fig. 2), there is no indication of growth beyond the second year. The life span of *C. zeylanicus* may be rarely entered into the third year. Shifter (1975) has also mentioned for chameleons in general that they grow quickly and many species "reach sexual maturity before the end of their first year. No one knows how old chameleons become in the wild, in terrariums they very rarely live longer than four or five years." Shifter's account, which is almost silent regarding the Indian chameleon, was perhaps mostly based on information on species of the African countries.

The TBL-SV-TL relationship is that of a straight line. The growth in body weight (W) (Fig. 3) with respect to SV does not follow a straight line and instead is proportionately high with the advancing body size.

Singh (1978) mentioned for the gharial (*Gavialis gangeticus*) that morphological features that do not have a functional significance at the time of hatching show a suppressed growth during in-the-shell stage of development. The same phenomenon is expected to being shown by the casque in *C. zeylanicus.* The casque is not developed in hatchlings (Singh *et al.* 1984) and as seen in the present study the smallest chameleon that had possessed a casque on the head measured 58 mm (SV) at about two months old. The function of the casque as a digging organ for nesting female chameleon has been mentioned in Singh *et al.* (1984). Its presence in males is perhaps related to the male's extent of dominancy and use as an 'advertisement' during the breeding season. Morphological coloration seems to play a major role in chameleon displays during the breeding season (Bustard 1965, 1967). The proportion of head (skull) to SV is almost the same from young to the adult stage of the chameleon. The variations in SV-HC relationship (Fig. 3a) appear to be more due to the size of the casque.

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SOME ASPECTS OF THE POPULATION DYNAMICS OF THE BAT, *RHINOPOMA HARDWICKEI* IN A CAVE SYSTEM[1]

K. USMAN[2]

(*With three text-figures*)

Data on some aspects of the population dynamics of *Rhinopoma hardwickei* were obtained between August 1978 through December 1980 are given. Banding recoveries and multiple recaptures indicate that *R. hardwickei* do not migrate, showing high degree of philopatry throughout the study period. The sex-ratio was about 0.6:0.4, although different behaviour of the sexes may lead to biased sampling techniques. More males than females of the species studied were captured, but this is not interpreted to indicate a differential mortality. That would mean that both sexes exhibit similar survival rate. Since social behaviour in bats does not seem to limit population size (Twente 1955) that predation on bats by hawks, owls, owlets, falcon, shrews, snakes and other animals and possibly death from pesticide effects also may be the primary factors controlling population density. Population showed a slow increase during the study period. Natality and mortality curves nearly approximate exponential functions. The natality rate has been higher than the mortality rate throughout the study period. Probability of survival of females over the years after banding was constant and this resulted in constant fertility rate.

INTRODUCTION

In any population of living organisms, whether it is growing, declining or stable, there is a continual turnover of individuals through the process of birth, death, immigration and emigration. This process depends on the organisms' interactions with the environment and is affected by factors such as food availability, predation pressure and the competition between the individuals in a group for different resources. The schedule of survival and fertility constitutes the life history of an organism. The dynamics of a population, namely the changes in numbers and composition of a population, is a consequence of the life-history of the various individuals in a population. Such a study termed 'population dynamics' is essential in understanding the biology of bats.

The small insectivorous bat, *Myotis lucifugus* has been shown to have a rather remarkable life span of 24 years (Griffin and Hitchcock 1965). However such longevity records concern only exceptional individuals and such records are of little value in understanding the population dynamics of a species. Several studies have been made on the theoretical age structures for bat population (Twente 1955, Davis 1966) survival rate of young *M. austroriparius* (Foster *et al.* 1978), population ecology of the bat, *M. grisescens* (Tuttle 1975) and mortality of the bat, *Eptesicus fuscus*

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(Kunz 1974). These studies involve banding of bats are mainly concerned with the homing abilities and migratory patterns. Pearson *et al.* (1952) attempted to study the reproductive biology of *Corynorhinus rafinesqui* in nature employing wing banding.

Apart from Sarkar *et al.* (1980) there are no systematic field studies on population strategies reported for bats of South India. It is very difficult to estimate population parameters of nocturnal animals such as bats within a short span of time. The aim of this study is to evaluate some of the results obtained from single marking and multiple recapture methods.

MATERIALS AND METHODS

The study cave lies very close to the pass of Nagamalai ridge, 8 km from the Madurai Kamaraj University campus (9°58′N, 78°10′E). The pass is called 'Kanavai Katha Bootham' (abbreviated KKB). The cave is occupied exclusively by a resident population of *R. hardwickei.* The following criteria were taken into consideration while selecting the banding site KKB: (a) easy accessibility to day time retreats and (b) possibility of easy visual observation of the roosting site. The presence of alternative roosting sites within a short radius also enabled me to recapture bats when necessary. The climate of this area is that of typical tropical plains with long and dry summers and mild winters. Weekly trips were made to KKB for banding from August 1978 to December 1978.

The bats were captured with nets brought to the laboratory in mosquito net cages and thin aluminium bands with numbers engraved on them, weighing *c* 200 mg were used for banding as suggested by Bonaccorso *et al.* (1976). Since these bands were flanged as specified by Stebbings (1978) there was no injury. One hundred bats were marked with coloured celluloid bird rings (Hughes, England). Males were marked on the right fore-arm and females on the left fore-arm. Wing membranes were not slit. Chewing of bands and irritation to wing membranes were not observed markedly in any of the study animals. Helpless young were not banded. The marked animals were taken back to the cave on the same night and released for free mixing. 646 males and 354 females of *R. hardwickei* were marked and released for the study of population ecology.

A total of one thousand bats were banded during a period of five months. The banded bats were recognizable from a distance of five metres at their day-time retreats with a small number of non-banded bats. The existence of banded bats could be clearly made out, even without seeing them, since the bands made a rustling noise, when the bats moved. Bands could be recognized even after a lapse of 24 months and the numbers were not disfigured. The bands did not seem to interfere with the normal activities of the bats.

RECAPTURE

The bats were recaptured upon emerging from the cave mouth, on the first week of every month during the study period. About one hundred were recaptured in any given month. The sexes, reproductive condition and band numbers were noted. The bats were then released immediately. Recapture study lasted for twenty four months from January 1979 through December 1980.

TOTAL COUNTS

Weekly visits were made to the cave at the time of emergence. The observer lay down on the rock facing the horizon to count the number of bats emerging for foraging. This caused no panic in their normal routine. Since the emerging bats and the twilight produce a complementary effect making the animal distinct, visual counts were possible. The bats were counted visually from August 1978 through December 1980.

Birth and Death Rates

Birth and death rates are dependent of age of individuals and of the size of the population. Migration will also cause marked fluctuation in population status. From the observed data, the estimation of existing banded animals and the size of the population can be drawn. Since life span and age structures of bats are not known, a crude method can be developed to compute the birth and the death rates of *R. hardwickei*. We can take advantage of the fact that the number of banded bats will change only through death and emigration, while the total number of bats will also be affected by birth immigration. The estimates of these two parameters were made in the following fashion.

Mortality Rate (μ_t)

μ = Mortality rate
Ti = Visual count in the month i
Ci = Total number captured in the month i
Ri = Recaptured banded bats in the month i

$$\left.\begin{array}{l}\text{Estimate of the total number}\\ \text{of bats at time i}\end{array}\right\} = \frac{Ri}{Ci} \times Ti$$

Then,

$$\mu i,\ i\text{-}1 = \frac{\left[\dfrac{Ri\ 0}{Ci} \times Ti\right] - \left[\dfrac{Ri-1}{Ci-1} \times Ti - 1\right]}{1/2 \left[\dfrac{Ri-1}{Ci-1} \times Ti - 1\right] + \left[\dfrac{Ri}{Ci} \times Ti\right]}$$

In words, this is the difference in the number of banded bats in the time intervals i – 1 and i. To calculate the rate per individual, the difference obtained is divided by the mean population estimate of banded bats during this period. Birth and immigration will not affect the number of banded bats, since these will not be banded.

Birth rate (λ)

The recruitment rate, which includes birth and immigrations, of a population can be calculated relating its mortality rate. The method employed was as follows:

Let
λ = Recruitment rate
μ = Mortality rate
Ti = Total counts in the month i

Then

$$i,\ i\text{-}1 = \left[\frac{Ti - Ti - 1}{Ti}\right] + (\mu i,\ i\text{-}1)$$

(or) Change in population/Individual-mortality rate (assumption underlying this is that the death and emigration rate are the same for the banded and total population).

Population of surveying over the year

Change occurs in the ratio of banded animals. This change does not occur at a relatively constant rate. So the rate of change over each month can be used to estimate the mortality over the year.

Therefore,

$(1 + \mu \text{ year}) = (1 + \mu i) \cdot (1 + \mu 2) \ldots (1 + \mu n)$

This is the probability of surviving through the specific year, for any individual, regardless of age and sex differences.

To have a comparative account of death and birth rates over a year, the following calculations were made:

Birth rate over a Yr. = $\lambda 1 + \lambda 2 + \lambda 3 \ldots\ldots \lambda 12$
Death rate over a Yr. = $\mu 1 + \mu 2 + \mu 3 \ldots\ldots \mu 12$

The relation between these two variables is therefore equivalent to the increase or decrease of *R. hardwickei* population in the study area.

BIRTH RATES OF SEXES

The combined population of bats maintains themselves long enough. The outcome of recapture data unaffects the proportion of females in relation to males. Proportion of females remains quite constant around 29-35% of females in the population through the study period, hence, no evidence for differential mortality by sexes (Fig. 3). Then the birth rate of females alone can be drawn.

$$\left.\begin{array}{l}\text{Ideally the birth rate}\\ \text{of females therefore}\end{array}\right\} \frac{\text{Birth rate}}{2}$$

RESULTS

From the one thousand bats that were banded at the study cave, 1299 recoveries were made from January 1979 through December 1980. Of these 876 were banded males and 423 were banded females. Table 1 gives the details of recovered bats during the study period. The average number of recaptured banded bats was almost the same for any given month. The recoveries include multiple recapture (on different dates) of individual bats (Table 2). The total number of banded and unbanded bats handled during the study period is presented in Table 3. The sexes are treated separately.

The degree of recaptures in relation to the period after banding decreased after a lapse of time. Table 1 illustrates that the first month after banding, recaptures were relatively high. This gradually decreased as the duration between banding and recaptures increased. Multiple recaptures were very few but extend even upto seven times (Table 2). Frequency of recaptures for the second and the third times was more during the first few months. However, bats were recaptured even after two years. Efforts to locate the banded bats during this period at other alternate sites resulted in only one banded bat being recaptured in an adjacent cave at *Pannian Malai.* This suggests that *R. hardwickei* form relatively stable population showing great loyalty to their original roosting site.

Table 1 shows the population fluctuation of *R. hardwickei* during January through December 1980. The data was obtained by visual count while the bats emerged out for foraging. The word population is used here with a meaning to indicate the number of bats occupying the KKB cave. It is interesting to note that population has been steadily increasing throughout the study period.

Several features of population parameters of *R. hardwickei* are apparent from Table 4 and Figs. 1 and 2. It constitutes the birth rate, the mortality rate and the relation between birth and death rates. The relative proportion of recaptured banded females to that of recaptured banded males remained more or less constant throughout the study period (Fig. 3). This will indicate the equal survival percentage of sexes. Since proportion of females remained constant over the study period, the fertility rates were evaluated to be 0.0755 and 0.0695 in 1980 (Table 4 and Fig. 3).

The shape of the mortality curve (μ) has been similar to the birth rate curve (λ) over the study period (Fig. 1). However, lower mortality rate was observed as —0.226 against the higher birth rate which was as +0.290 during the study period. Probability of sur-

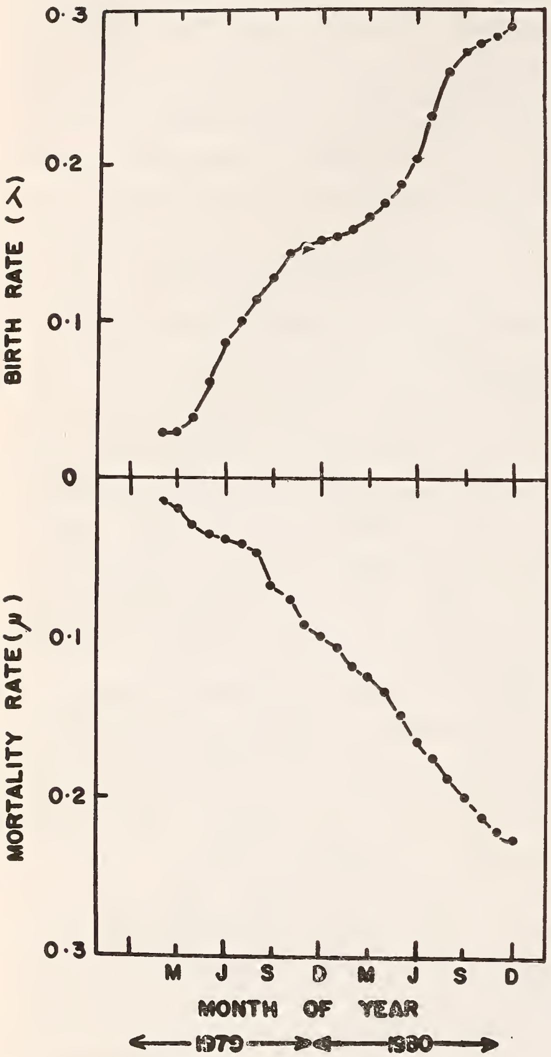

Fig. 1. Birth and death rates for *Rhinopoma hardwickei* population in the cave at KKB. Cumulative rates have been given for the years 1979 and 1980.

viving banded bats after two years showed an exponential decay (Fig. 2). Even so probability of surviving banded bats after two years is characterized by higher survival score of 0.796.

DISCUSSION

This attempt of population analysis by banding is just a beginning for a full scale study of population dynamics. Though this should be continued for the entire life span of the species in question, the results from the present study are encouraging. Recapture rates and multiple recaptures were fairly high (Tables 1, 2 and 3) and banding produced no observable mortality. This is due to the continuous occupation of the same colony in the same cave and low migration rate, although there are a few alternative roosting sites available nearby. That means the colony is stable. The results show similarities to those of Pearson *et al.* (1952) in which the population of *Corynorhinus* was extremely stable. The frequency of recaptures both in relation to the number of times recaptured and the time lag indicate specificity for day time retreat as reported for some European congeneric species (Griffin 1970). These need not however, suggest that the territory of *R. hardwickei* is restricted, since it is possible that they might fly considerable distances for foraging, as several bird species are known to do (e.g. Ward and Zahavi 1973).

Population size was monitored with evening flight counts at the roost. Weather had a profound influence on bat behaviour and habitat use (Usman 1981). Numerous potential predators like owls, owlets, falcons, shrews and snakes frequented the roosts and its vicinity. Yet the fluctuation in the number of bats in the cave for any observed month was extremely limited which means that these bats normally do not migrate even for a short distance. Even during non-breeding season, the males and females were segregated in the same

TABLE 1

DETAILS OF RECAPTURES OF *R. hardwickei in* KKB

Month	Visual count	Recaptured banded males	Recaptured banded females	Captured unbanded males	Captured unbanded females	Total capture
1979						
J	934	48	24	18	8	98
F	976	47	23	21	10	101
M	981	46	22	22	9	99
A	1000	44	22	21	12	99
M	1030	44	21	26	10	101
J	1060	42	21	25	13	101
J	1078	43	20	26	14	103
A	1100	42	20	28	14	104
S	1138	40	21	30	17	108
O	1166	39	20	30	19	108
N	1190	39	19	31	21	110
D	1203	37	20	33	20	110
1980						
J	1215	38	19	35	20	112
F	1235	36	18	36	19	109
M	1251	35	16	36	18	105
A	1275	35	15	36	20	106
M	1310	32	15	37	20	104
J	1354	32	14	39	22	107
J	1407	29	14	43	19	105
A	1465	27	13	44	19	103
S	1503	27	13	44	23	107
O	1532	26	12	44	23	105
N	1553	24	11	42	22	99
D	1574	24	10	43	21	98

TABLE 2

RECOVERY ABSTRACT OF BANDED *R. hardwickei* IN KKB DURING 1979 AND 1980

Frequency	Recaptured banded males	% of recaptured banded males	Recaptured banded females	% of recaptured banded females	Recaptured banded bats (combined sexes)	% of recaptured banded bats (combined sexes)
Once	173	26.78	225	63.56	398	39.80
Twice	142	21.98	30	8.48	172	17.20
Thrice	40	6.19	17	4.80	57	5.70
Four times	26	4.03	13	3.67	39	3.90
Five times	12	1.86	7	1.98	19	1.90
Six times	12	1.86	0	0	12	1.20
Seven times	9	1.39	0	0	9	0.90
Never recaptured	232	35.91	62	17.51	294	29.40

TABLE 3

TOTAL POPULATIONS AND SEX-RATIO OF *R. hardwickei* HANDLED AT KKB DURING THE STUDY PERIOD

Year	Banded males	Unbanded males	Banded females	Unbanded females	Total handled	% of males	% of females
1978	646	—	354	—	1000	64.60	35.40
1979	511	—	253	—	764	66.88	33.12
1979	—	311	—	167	478	65.06	34.94
1980	365	—	170	—	535	68.22	31.78
1980	—	479	—	246	725	66.07	33.93

roost but neither made any local migration, indicating a great fidelity to the roosting site as seen in for instance the gray bats (Tuttle 1976). Such a philopatry to a particular habitat appears to be a general phenomenon among bats (Humphrey and Cope 1976, Rice 1957). The exception to this is the roosting habit of a tropical microchiropteran bat, *Tadarida aegyptiaca* found close to my study area frequently. Large colonies of *Tadarida* have been noticed during my study to disappear overnight.

This spatial fidelity may result in overcrowding. Visual count exhibited a marked change in the population size during these years. It is obvious that there is also an upper limit to colony size beyond which increasing numbers are no longer advantageous. This limit may be determined primarily by the abundance of food resources available to the colony and by the availability of roosting sites (Tuttle 1976).

The birth and death rate curves (Fig. 1 and Table 4) from the observed data nearly approximate exponential functions. Caughley (1966) has shown that high juvenile morta-

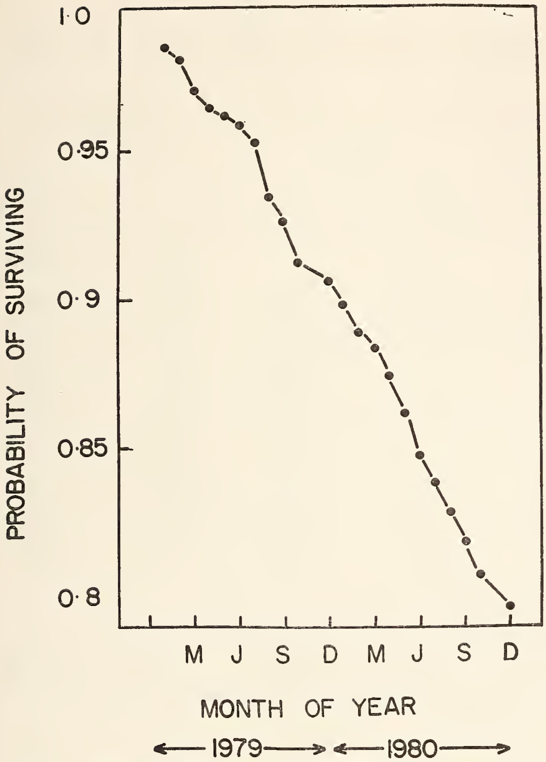

Fig. 2. Probable survivorship curve for *Rhinopoma hardwickei* population in the cave at KKB. Cumulative data are given for the years 1979 and 1980.

lity is an ubiquitous of mammalian survival patterns. Humphrey and Cope (1977) have emphasized that studies of bat survival beginning at or after weaning always misplace survival curves if study is short term. The same error occurs in all studies of animal survival in which the cohorts are marked sometime after birth (Foster *et al.* 1978). Ordinary population dynamics data are independent of age structure. If so a few legitimate interpretations are possible from the observed data for *R. hardwickei.* Figs. 2 and 1 show the annual change in survival potential. Loss during the second year after banding was greater than the first year. The mortality rate begins very low at —0.098 and claims to a higher annual rate at —0.128 in the second year. Birth in course of these years compensated the loss. We can envision this as a demographic adjustment necessitated by the higher mortality. Pearson *et al.* (1952) recognised a similar pattern of survival for lump nosed bats. The observed mortality includes the death of bats of all age structures. These are real rather than random deviations as observed by Davis (1966) for *Pipistrellus subflavus.* Davis (1966) pointed out that a change in the function will be apparent at the other end of the curve, as survival decreases beyond certain years and fall sharply as they approach maximum life span. Several species exhibit survival curves which approximate a constant percentage loss among all age groups (Davis 1966). This requires further study for confirmation. That would mean that an exponential decay curve would apply to an animal population if all losses are due to predation or decrease acting equally upon all age groups. Age is important in determining survival rates but its effects would be of gradual change. However, based on the frequency of bats captured by predators there was no apparent difference in the proportion of adults and juveniles preyed upon by these predators. Predation and the loss of babies falling to the floor account for most of the yearly mortality. Application of pesticides to the crops by the local farmers forms one of the causes to non-specific age related mortality.

Probability of surviving banded males and females, two years after banding showed high survival rates (Fig. 3) indicating high degree of tolerance. The survival percentage of females has been on par with the survival percentage of males throughout the study period (Table 4 and Fig. 3). Twente (1955) estimated that

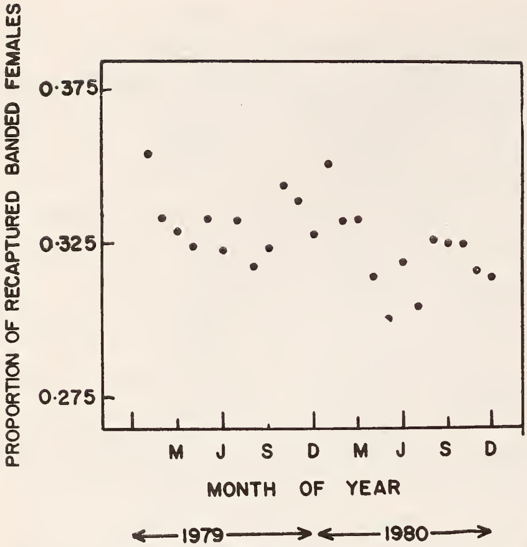

Fig. 3. Proportion of recaptured banded females of *Rhinopoma hardwickei* in relation to males over the study period.

in a population of bats in which each female has only one young per year, a constant of 66.7% survival rate (i.e. 33.7% = mortality rate) must operate if the population is to stay at the same size. *Rhinopoma* produces one young in a year. The birth peak occurs in May, June and July. Weaning extends upto November. The observed data on birth and death rates bear evidence for the continuous living of the colony in a particular cave and slow increase of population size.

TABLE 4

COMPARATIVE ACCOUNT OF BIRTH AND DEATH RATES OF *R. hardwickei* IN THE KKB CAVE OVER THE STUDY PERIOD

Month	1979		1980	
	λi	μi	λi	μi
J	—	—	0.002	—0.008
F	0.029	—0.014	0.005	—0.011
M	0.001	—0.004	0.007	—0.006
A	0.008	—0.011	0.009	—0.010
M	0.023	—0.006	0.012	—0.015
J	0.025	—0.003	0.016	—0.017
J	0.014	—0.003	0.028	—0.010
A	0.014	—0.006	0.028	—0.012
S	0.013	—0.020	0.013	—0.012
O	0.015	—0.009	0.006	—0.013
N	0.005	—0.015	0.005	—0.009
D	0.004	—0.007	0.008	—0.005
Birth and death rates over the years	0.151	—0.098	0.139	—0.128
Cumulative rates of birth and death over the study period			0.290	—0.226

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A CATALOGUE OF THE BIRDS IN THE COLLECTION OF BOMBAY NATURAL HISTORY SOCIETY — 30

MUSCICAPIDAE (Sylviinae)

HUMAYUN ABDULALI

[*Continued from Vol.* 82(1): 113]

This part covers 1141 specimens of 107 species and subspecies, Nos. 1471-1571 in INDIAN HANDBOOK & SYNOPSIS, and 15 extralimitals. The latter are largely from Iraq (then Mesopotamia) and Iran (Persia) where members of the Society in military and political services collected. Of the 107 from Indian limits we have no specimens of 26 forms and this is some indication of the incompleteness of the collection, which is perhaps the best in India. Mr. Eric D'Cunha assisted in my work but went over to another project before the work was completed. Dr. (Mrs.) S. Unnithan has helped in tying up the ends.

1471 **Tesia cyaniventer** Hodgson (Nepal) Yellowbrowed Ground Warbler 1: 463

14: 4 ♂♂ 6 ♀♀ 4 o?

1 Eastern Himalayas; 1 Rangpo, 1 Berrik, 1 Singtam, Teesta Valley, Sikkim; 2 Gedu, 1 Samchi, West, 3 Shamgong, Central Bhutan; 1 Doyang, Sibsagar District, 1 Goma Reserve, Goalpara, Assam; 1 Roopachena, Cachar; 1 *Mt. Victoria, Burma.*

Measurements on p. 149.

1472 **Tesia olivea** (McClelland) (Assam) Slatybellied Ground Warbler 1: 463

12: 3 ♂♂ 5 ♀♀ 4 o?

1 Rangpo, Sikkim; 2 Samchi, West, 1 Tama, Central Bhutan; 1 Dening, Lohit Valley, 2 Margherita, Assam; 3 Miao, 2 Firm Base, Tirap District, Arunachal Pradesh.

Measurements on p. 149.

1473 **Tesia castaneocoronata castaneocoronata** (Burton) (Himalayas, restricted to Nepal) Chestnutheaded Ground Warbler 1: 465

17: 3 ♂♂ 6 ♀♀ 8 o?

1 Koti, Bhagat State, 3 Simla, NW Himalayas; 1 Dikchu, North, 1 Singtam, Teesta Valley, Sikkim, 1 Bhutan Duars; 2 Honka, West, 2 Tama, 2 Shamgong, 1 Batase, Central, 1 Gomchu, 2 Rongtong, E. Bhutan.

There are no juveniles in the collection.

Measurements on p. 149.

1474 **Cettia pallidipes pallidipes** (Blanford) (Sikkim) Indian Palefooted Bush Warbler 2: 508

1 ♂ Dehra Dun.

This specimen was found among the tailor birds, *Orthotomus sutorius* !

Measurements on p. 149.

1475 **Cettia pallidipes osmastoni** (Hartert) (Andaman Is.) Andaman Palefooted Bush Warbler 2: 509

nil.

1476 **Cettia diaphone canturians** (Swinhoe) (Amoy in winter, Shanghai in summer) Chinese Bush Warbler 2: 511

nil.

1477 **Cettia montana pallida** (Brooks) (Kashmir) Pale Strongfooted Bush Warbler 2: 507

13: 6 ♂♂ (2 juv.) 4 ♀♀ 3 o?

1 Chhoi, near Campbellpur, 1 Ghora Gali, Murree Hills, 1 Rawalpindi, Pakistan; 1 Chandigarh, Punjab; 2 Kufri, 1 Patiala State, 1 Solon, Bhagat State, 1 Baghi Bushahr State, 4 Simla, N. W. Himalayas.

One female and one young male Nos. 17290 and 17289 collected at Kufri, 8600′ Patiala State, are marked as of the species *Tribura luteiventris* (now *Bradypterus luteoventris luteoventris* No. 1493 where they were registered). They were also so recorded by A.E. Jones in 1919 (JBNHS 26 p. 605) but omitted in his subsequent paper of 1948 (loc. cit. 47 p. 415) being really the present species. Whistler's mss notes refer to these specimens being examined by Ticehurst and said to be *H. pallidus* (now *C. montana pallida*). Of the remaining eleven specimens one is marked *pallidus* by Ticehurst and the others by the collectors, Osmaston and Jones.

Measurements on p. 149.

1478 **Cettia montana fortipes** (Hodgson) (Nepal) Strongfooted Bush Warbler 2: 506

16: 9 ♂♂ 3 ♀♀ 4 o?

7 Gedu, 2 Phuntsholing, 1 Chimakhoti, 3 Honka, West, 1 Batase, Central, Bhutan; 1 Tezu, Lohit Valley, 1 Margherita, Assam.

Some birds from Bhutan were marked *pallidipes* and led to considerable delay and confusion.

Measurements on p. 149.

1479 **Cettia major major** (Moore) (Nepal) Himalayan Large Bush Warbler 2: 510

nil.

1480 **Cettia major vafer** (Koelz) (Phulbari, Garo Hills) Assam Large Bush Warbler

nil.

1481 **Cettia flavolivacea flavolivacea** (Hodgson) (Nepal) Himalayan Aberrant Bush Warbler 2: 502

2: 1 ♂ 1 o?

1 Ringli, Ringliot, Sikkim, 1 Gedu, West Bhutan.

In the absence of any material for comparison, the subspecific name is based on distributional limits as in Ind. Handbook. These birds have yellow underparts while the key in Indian Handbook (8 p. 6) separates *C. acanthizoides* from the other Cettias as the only one with a yellow abdomen. The text on p. 13 refers to the present form as with yellowish underparts.

Measurements on p. 150.

1482 **Cettia flavolivacea stresemanni** (Koelz) (Mawryugueng, Khasi Hills) Assam Aberrant Bush Warbler 2: 503 (part)

nil.

1483 **Cettia flavolivacea alexanderi** Ripley (Phek-Meluri Road 60 miles east of Kohima, Naga Hills) Manipur Abberrant Bush Warbler 2: 503 (part)

nil.

1484 **Cettia acanthizoides brunnescens** (Hume) (neighbourhood of Darjeeling) Hume's Bush Warbler 2: 505

nil.

1485 **Cettia brunnifrons whistleri** (Ticehurst) (Simla) Western Rufouscapped Bush Warbler 2: 513

6: 2♂♂ 4 ♀♀

2 Patiala, 1 Koti, 3 Simla.

The specimens were collected between 1917 and 1927 and have their upperparts more rufous than in *brunnifrons* (1486) though the character is more distinct in the older skins.

Measurements on p. 150.

1486 **Cettia brunnifrons brunnifrons** (Hodgson) (Northern region of hills near Snows, Nepal) Eastern Rufouscapped Bush Warbler

9: 5 ♂♂ 2 ♀♀ 2 o?

1 Batase, 3 Tama, 1 Lodrai, Central, 1 Gomchu, 1 Tashigong, 1 Shamgong, Eastern Bhutan; 1 Tongloo, Darjeeling.

The last specimen goes back to August 1905 has the smallest measurements of wing, tarsus and tail (though in moult), is a juvenile and heavily foxed.

Measurements on p. 150.

1487 **Cettia brunnifrons muroides** (Koelz) (Bamanigaon Assam) Arunachal Rufouscapped Bush Warbler 2: 512 (part)

nil.

1488 **Cettia cetti albiventris** Severtzov (Kara Tau) Cetti's Warbler 2: 514

2 ♂♂

1 Jujjah Abbasian, Bahawalpur, Pakistan; 1 Bharatpur, Rajasthan.

These birds have been accepted as *albiventris* in IND. HANDBOOK (also Hussain, JBNHS 71 p. 611) but though larger they are much darker above than the next two from Western Iran listed as *orientalis*. On p. 264 of vol. 6 of BIRDS OF SOVIET UNION (1968), *albiventris* is said to be paler than *orientalis*.

Measurements on p. 150.

EL. **Cettia cetti orientalis** Tristram (Palestine) Mesopotamian Broadtailed Warbler

2: 1 ♂ 1 ♀

1 *Kermanshah*, 1 *Khurrandarrah, W. Iran.*

These two specimens were named as of this race by P. A. Buxton, 1921, JBNHS 27, p. 864.

See remarks above under 1488.

Measurements on p. 150.

EL. **Cettia squamiceps** (Swinhoe) (Canton) 2: 515

1 ♂ *Pegu Yomas, Burma.*

Measurements on p. 150.

1489 **Bradypterus thoracicus przevalskii** (Sushkin) (Dehachar Mts. Upper Hwangho) Western Spotted Bush Warbler 2: 405 (part)

nil.

1490 **Bradypterus thoracicus thoracicus** (Blyth) (Nepal) Eastern Spotted Bush Warbler 2: 405

1 o? 6 m. from Miao, Tirap Div., Arunachal Pradesh.

The spots on the breast are barely visible being more distinct in *B. major*, 1491.

Measurements on p. 150.

1491 **Bradypterus major major** (Brooks) (Cashmir) Longbilled Bush Warbler 2: 403

1 ♀ Gilgit Division.

The spots on the breast are more distinct than in 1490 referred to above as the Spotted Bush Warbler.

Measurements on p. 150.

1492 **Bradypterus tacsanowskius tacsanowskius** (Swinhoe) (Transbaicalia) Chinese Bush Warbler 2: 404

nil.

1493 **Bradypterus luteoventris luteoventris** Brown Bush Warbler 2: 406

1 o? Dumpep, Shillong, Assam.

This species was recorded in error from Kufri, 8600' Patiala State, — see under 1477.

Measurements on p. 150.

1494 **Bradypterus palliseri** (Blyth) (Ceylon) Ceylon Bush Warbler 2: 408

nil.

1495 **Lusciniola melanopogon mimicus** (Madarasz) (Transcaspia and Seistan in Iran) Moustached Sedge Warbler 2: 418

14: 2 ♂♂ 4 ♀♀ 8 o?

2 Jagadhri, Ambala; 1 Ladwa, Karnal Dt. Punjab; 4 Jajjah Abbasian, Bahawalpur State, 4 Bharatpur, Rajasthan, 1 Wanthi, Bhuj, Kutch; 1 Lucknow, U.P., 1 Rajputh, Saran, Bengal.

In SYNOPSIS 2nd Edition, 1982, the generic name is changed to *Acrocephalus.*

Measurements on p. 151.

1496 **Cisticola exilis erythrocephala** (Blyth) (Nilgiris) Redheaded Fantail Warbler 2: 420

2: 1 ♂ 1 ♀ Bababudan Hills 5000' and 4500' Kadur District, Mysore. Both obtained in January 1940.

Measurements on p. 151.

1497 **Cisticola exilis tytleri** Jerdon (Dacca, Bengal) Yellowheaded Fantail Warbler 2: 420

2: 1 ♀ 1 o?

1 Hasimara, Dalsingpara, Dooars, Bengal-Assam, 1 Bishenpur 3000' Manipur.

The first bird (July 1911) is very like *juncidis* but lacks the white tips to the tail while the second (January 1952) is almost black above with a very long tail. This was collected by O'Donel and only this species is referred to in O'Donel *et al.* 1920 paper on Vertebrates of Jalpaiguri Dist. JB 26 p. 988.

5 birds collected by Stuart Baker at Dibrugarh (1 in October 1904) and Shillong (4 in July 1908) and registered under *C. exilis tytleri* have white tips to the outer rectrices. The two males have faint rufous "mirrors" on the tail and also agree in measurements with *C. juncidis cursitans,* with which they are being listed.

Measurements on p. 151.

1498 **Cisticola juncidis cursitans** (Franklin) (between Calcutta and Banaras) Streaked Fantail Warbler 2: 422

37: 16 ♂♂ 13 ♀♀ 8 o?

1 Chakdara, Swat Valley, N.W.F.P.; 1 Jagashri, 2 Ambala, Punjab; 1 Delhi; 2 Bhinmal, Jodhpur State; 1 Ruthai, Gwalior State; 1 Mandvi, Kutch; 2 Golana, Cambay State, Gujerat; 1 Dodi, Malwa Plateau, Bhopal State; 1 Jubbalpore, C.I.; 1 Murbad, Kalyan, 1 Taloja, 2 Shil, 1 near Thana, 1 Churchgate, Bombay, Maharashtra; 1 Geedam, 3 Amraoti, Bastar, 2 Central Provinces; 1 Cape Comorin, Tamil Nadu; 1 Allahabad, 1 Meerut, U.P.; 1 Dibrugarh, 2 Naya Bungalow, 2 Barha Pani, 1 Shillong, Khasia Hills; 1 *Shardaung, Prome Dist.,* 1 *Myogwin, Henzada Dist., Burma;* 1 no locality.

In 1894 JB IX p. 12 in Birds of North Cachar, Stuart Baker referred to *Cisticola tytleri* all over the grass plateau and grass-covered hills to the north and north-west and recorded 2 types of nests. In the same place (p. 14) he mentions *C. volitans* Swinhoe "almost undoubtedly" and *C. cursitans* "breeding on the grassy summit of a hill over 4000 feet high". The Bombay collection included 5 specimens of *Cisticola* collected by Stuart Baker in Oct. 1901 (1) at Dibrugarh and July 1908 (4) at Barha Pani and Naya Bungalow, Shillong, the first marked *tytleri* on the original label and the others so registered. All these are *juncidis* (*cursitans*) and it is difficult to determine the reliability of the earlier identifications. Another collected by H. S. Walton at Meerut on 7-x-1898 and marked *Prinia lepida* was changed to *Cisticola cursitans* and again to *tytleri* where it was listed. All these appear to be *C. juncidis cursitans* and are now included therewith. The two from Burma are not as dark as the Nicobar birds under *malaya* under 1500(a).

Measurements on p. 151.

1499 **Cisticola juncidis salimalii** Whistler (Peermade, Travancore) Kerala Streaked Fantail Warbler 2: 422 (part)

3 ♀♀

1 Kumili, 1 Maraiyur, 1 Velayan Lake, Trivandrum, Kerala.

The three females (January, March & April) are barely separable from *cursitans.*

Measurements on p. 151.

1500 **Cisticola juncidis omalura** Blyth (Ceylon) Ceylon Streaked Fantail Warbler 2: 424

2: 1 ♂ 1 o?

1 Ratnapura, 1 Wevala, Western Province, Ceylon.

The first (10 Feb. 1914) appears more heavily marked and darker than the other (14 March 1921) which would pass among *C. j. cursitans* from India. The former has a thick bill 3.2 mm. at the nostril. The latter has it slightly thinner but does not taper to a fine point as in *cursitans.*

Measurements on p. 151.

1500a **Cisticola juncidis malaya** (Lynes) (Klang, Malay Peninsula) Malay Streaked Fantail Warbler

8: 5 ♂♂ 3 ♀♀

2 Car Nicobar; 6 Camorta, Central Nicobars.

The bills appear heavier than in *cursitans.* The identifications are based on one from Car Nicobar named by Dr. Ripley, JBNHS 64 p. 185.

Measurements on p. 151.

EL. **Cisticola juncidis neurotica** Meinertzhagen (Sidon, Syria)

2: 1 ♂ 1 o?

1 *Sheikh Saud,* 1 *left bank of Shatt-el-Arab Basrah, Iraq.*

The race was named because of its neurotic behaviour ! Ticehurst JB 31 p. 102 says that though a series from Baghdad did not differ from Palestine birds, he could not determine the race in Iraq and placed them under *neurotica.* Vaurie 1959, p. 311, gives the distribution as Near East (intergrading with nominate *juncidis*) and Iraq, to the foothills of Zagres in Western Iran. They are left here on geographic grounds.

Measurements on p. 151.

1501 **Prinia rufescens rufescens** Blyth (Arracan) Rufous Wren Warbler 2: 427

19: 7 ♂♂ 8 ♀♀ 4 o?

1 Singtam, 1 Kalizhora, Teesta Valley, 1 Martam, Rongni Valley, 1 Pershoke, 1 Rangpo, Sikkim; 5 Dibrugarh, Assam; 1 Moirong, Manipur; 2 *N. Shan States,* 1 *Maymyo,* 1 *Nyanggyo, Prome Dist.,* 1 *Legongyi, Henzada Dist.,* 3 *Ataran, Burma.*

Sp. No. 5672 from N. Shan States, 5 August 1913, is very rufous below and agrees with the description of *austeni,* Stuart Baker, described from Lhota, Naga Hills (wrongly(?) quoted as Chota Naga Hills in *Fauna*) but discredited in Indian Handbook.

Measurements on p. 152.

Prinia hodgsoni

Stuart Baker's Fauna Vol. 2 (1924) accepted one form of this species from India, Burma & Ceylon under the name of *gracilis.* In SYNOPSIS (1961 and 1982) and INDIAN HANDBOOK Vol. 8 (1973) four races are accepted but the keys and description are not very clear and the present specimens are separated on the geographical limits indicated therein referring to the difficulties/inconsistencies which still remain. Yellow on the chin and underparts is said to be a juvenile character but is in many instances linked with the grey band across the breast, which is presumably a breeding plumage. As in *Cisticola* spp. they have longer tails in winter, out of the breeding season. In all races the summer and winter tails are separately measured. An attempt to separate them in accordance with the presence/absence of yellow on the chins and the grey band across the breast, both together and separately led to no geographical groupings or other findings except that all the 8 birds with both a yellow chin and the band across the breast are males !

1502 **Prinia hodgsonii rufula** Godwin-Austen (Naga Hills, N.E. Bengal) Northern Ashy-grey Wren-Warbler

19: 11 ♂♂ 4 ♀♀ 4 o?

1 Mubarikpur, near Ambala, Punjab; 2 Bhagat State, 1 Sairi, 1 Kalka. 1 Patiala State; 1 Gurna, 1 Almora, Kumaon; 1 Dehra Dun, U.P.; 1 Sukna, Darjeeling; 1 Sanchi, West Bhutan; 2 Dibrugarh, 1 Barhapani, Shillong, Assam; 1 Roopchena, Cachar; 1 *Maymyo*, 1 *Pakokku*, 1 *Thayetmyo, Burma*, 1 no locality.

Specimens dated 4th June (Simla Hills), 30th June (Almora), 11 July (Patiala Hills) and 31 August (Almora) have bands across the breast *contra* Ticehurst & Whistler's statement (*Ibis*, 1939, p. 762) that birds from the Himalayas have no pectoral band.

Measurements on p. 152.

1503 **Prinia hodgsonii hodgsonii** Blyth (Vindhya Hills) Franklin's Ashy-Grey Wren-Warbler

2: 425 (part)

26: 14 ♂♂ 8 ♀♀ 4 o?

3 Jaswantpura, Sunda Hills, Jodhpur; 1 Bhuj, 1 Rudramata, 1 Mata-no-Madh, 1 Dabka, Baroda; 1 Laochati, 1 Pandwa, Surat Dangs, Gujerat; 2 Dodi, Bhopal State; 1 Jubbulpore; 1 Kolkaz, Melghat, 1 Amraoti, 1 Jalgaon, East Khandesh; 1 Bassein, 1 Murbad Road, Kalyan, Thane Dist.; 1 Ratnagiri, Maharashtra; 1 Karwar, 1 North Kanara; 1 Bhanupratappur, Kanker, 1 Darla, 1 Barsu, Bastar, C.P.; 1 Chahala, 2 Gurguria, Simlipal Hills, Orissa.

These are subspecifically named on the basis of the map in INDIAN HANDBOOK 1973 (8 p. 41), though the birds from Bombay are very similar to *albogularis* from the south.

Measurements on p. 152.

1504 **Prinia hodgsonii albogularis** Walden (Coorg) Southern Ashy-Grey Wren Warbler

2: 425 (part)

11: 6 ♂♂ 3 ♀♀

1 Bandipur, 1 Biligirangan Hills, Mysore; 1 Begur, Manantoddy, 1 Santanpara, Cardamon Hills; 1 Balamore, Ashanti, 1 Tirthamalai, Salem Dist; 4 Palkonda Hills, South Cuddapah, 1 Anantgiri, Vizagapatnam.

This group contains only two birds collected at Tirthamalai, Salem Dist. on 23 June and Bandipur *c.* 3300′, Mysore State, on 19 November, lacking the breast band, both with yellowish bills indicating juvenility.

Measurements on p. 152.

1505 **Prinia hodgsonii pectoralis** Legge (Hambantota Dist., Ceylon) Ceylon Ashy-grey Wren-Warbler 2: 425 (part)

nil.

1506 **Prinia buchanani** Blyth (Bengal) Rufousfronted Wren-Wrabler 2: 429

26: 18 ♂♂ (2 juv.) 6 ♀♀ 2 o?

1 Sufi Telaw, 1 Pithoro, Sind; 1 Campbellpur, 3 Ambala, Punjab; 3 Delhi; 2 Harunabad, Bahawalpur State; 3 Hamavas Lake, 1 Tilwara, Jalor, Jodhpur State; 1 Kano, 1 Santanwara, Gwalior State; 2 Bhujia Fort, Kutch, 1 Kharaghoda, 1 Dalkhonia, Amreli Dist.; 1 Wadala near Belapur, Ahmednagar Dist.; 1 Gaya, C. P.; 2 Cawnpore, U.P.

2 *Prinia hodgsonii* and a *Prinia sylvatica* were entered under this species while one *buchanani* was found under *P. hodgsonii.*

Measurements on p. 153.

1507 **Prinia cinereocapilla** Hodgson (Nepal) Hodgson's Wren-Warbler 2: 428

nil.

1508 **Prinia gracilis lepida** Blyth (Sind) Indian Streaked Wren-Warbler 2: 526

15: 8 ♂♂ (1 juv.) 3 ♀♀ 4 o?

1 Korak, Kalat, Baluchistan; 1 Phulji, 1 Dodu, Larkana, 1 Pithoro, Sind; 1 Attock, River Indus; 1 Lahore, Punjab; 1 Manthar, 1 Bahawalpur town; 1 Delhi; 3 Golana, 1 Devisar Tank, Bhuj, 1 Mandvi Kutch; 1 Fattegarh, U.P.

The key to species in IND. HANDBOOK 8, p. 37, separates this as having the "upperparts not streaked" but this is in error.

Measurements on p. 153.

1509 **Prinia gracilis stevensi** Hartert (North Lakhimpur) Eastern Streaked Wren-Warbler 2: 527

2 ♂♂ Miao, Tirap Div., Arunachal Pradesh.

One male obtained on 8 March had enlarged gonads. Both can be easily separated from *lepida* above.

Measurements on p. 153.

EL. **Prinia gracilis irakensis** Meinertzhagen (Baghdad) Iraq Streaked Wren-Warbler

9: 5 ♂♂ 1 ♀ 3 o?

2 *Akeika, Euphrates,* 2 *Baghdad,* 1 *Amara,* 1 *Shaiba, Iraq*; 1 *Shiraz,* 2 *Seistan, Iran.*

All are in very poor condition, but appear paler above and it is possible that the streaks are more prominent. The type locality of *lepida* is also at the edge of the semi-desert area and these can only be named on geographical grounds. They are all marked *lepida* for they were presumably last examined by Ticehurst (?) prior to the description of *irakensis* in 1923. The wings are slightly smaller and the bills slightly larger than in *lepida.*

Measurements on p. 153.

Prinia subflava

With the winter, summer, intermediate and juvenile plumages, it is not possible to identify the material available with any degree of certainty, and they are subspecifically named in accordance with the distribution accepted in INDIAN HANDBOOK.

1510 **Prinia subflava terricolor** (Hume) (N. W. India = Oudh, Agra) Northwestern Plain Wren-Warbler 2: 534

37: 22 ♂♂ 8 ♀♀ 7 o? (5 summer Aug/Oct.; 7 long rufous tail Nov-Feb.; 21 rufous wash above & long tail Nov/Dec.; 4 Feb/March pre-summer). 3 Pithoro, Sind; 1 Lahore, 2 Shikohpur, Jullundur, 5 Ambala, Punjab; 1 Dehra Dun, 3 Ganges Canal, 2 Meerut, U.P.; 1 Delhi; 1* Gonda, Oudh; 1 Daulatpur, 1 Bhung, 1 Harunabad, Bahawalpur State; 2 **Hamavas Lake, Jodhpur State; 1 Kuno, 1 Satanwara, Gwalior State; 1 Ratlam, C. India; 1* Bhachau, 1* Rudra-Mata, Kutch; 1 Radanpur, North 1 Vaghjipur, 1 Patan, Mehsana Dist., 1 Kodiwar, South Kathiawar, 1 Golana, Cambay City, 1 Nadiad Town Environs, 1 Mehmudabad, Kaira Dist., 1 Dabka, Baroda Dist., Gujerat.

The 5 birds marked* are in summer plumage (2 in August, 1 Sept., 2 Oct.) and perhaps the most strikingly different in the whole series.

Measurements on p. 153/54.

1511 **Prinia subflava inornata** Sykes (Dukhun) Central Indian Plain Wren-Warbler

38: 24 ♂♂ 11♀♀ 3 o? (5 summer August-October, 6 long rufous tails November-February, 22 rufous wash and long tail November-December, 4 pre-summer February-March).

1 Jaithari, Bhopal State; 5 Santa Cruz, 1 Andheri, 1 Saki, Salsette, 1 Upper Colaba, Bombay; 1 Borde near Bombay, 2 Thana, 1 Kalyan; 1 Hashivra, Kolaba; 1 Nasik, 1 Poona, Maharashtra, 1 Karwar, North Kanara; 1 Kurumbapatti, Salem Dist., 1 Koduru, South Cuddapah; 1 Wangabi Tank, Nellore, A.P.; 1 Keonjgarh, 1 Barambo, 1 Anantpur, Orissa; 3 Chota Dongar, 2 Bailadila, Bastar, 1 Saugor, M.P., 1 Monghyr, 1 Madhubani, Bihar, 7 Cawnpore.

The birds in summer plumage have slightly darker upperparts than *terricolor* in the same plumage.

Measurements on p. 153/54.

1512 **Prinia subflava fusca** (Hodgson) (Nepal) Eastern Plain Wren-Warbler

2: 1 ♂ 1 o? (both pre-summer March)

1 Tama, Central, 1 Rongtong, Eastern Bhutan.

Both have prominent black subterminal tips to tails and are slightly browner above than *inornata* (1511).

Measurements on p. 154.

1513 **Prinia subflava franklinii** Blyth (Nilgiris) Nilgiri Plain Wren-Warbler

7: 3 ♂♂ 1 ♀ 3 o? (1 summer Sept.; 3 rufous wash & long tail Jan-Feb.; 3 pre-summer Jan-March).

1 Lingadahally, Sagar, Mysore; 1 Upper Bhavani, Nilgiris; 1 Thattakad, 2 Amakel, 1 Kottayam, 1 Kumili, High Range, Travancore.

Measurements on p. 154.

1514 **Prinia subflava insularis** (Legge) (Hurelle Tank, N.C.P. Ceylon)

nil.

EL. **Prinia subflava burmanica** Harington (Mandalay) Burmese Wren-Warbler 2: 536

6: 2 ♂♂ 3 ♀♀ 1 o?

1 *Upper Burma;* 1 *Tahenaw,* 2 *Prome;* 1 *Neikban, Henzada;* 1 *Ataran R., s. of Moulmein, Burma.*

All have heavier bills than in the other races and are also darker above, rather than below.

One with no data except "Upper Burma" has a black bill and all show a varying amount of rufous wash below.

The two from Ataran R., south of Moulmein and from Neikban, Henzada, have the upperparts slightly paler than in the others.

Measurements on p. 154.

1515 **Prinia socialis stewarti** Blyth (near Agra) Northern Ashy Wren-Warbler

18: 13 ♂♂ 4 ♀♀ 1 o?

2 Shikohipur, Jullunder, 3 Ambala, 1 Chandigarh, Punjab; 2 Delhi; 1 Surawayo, 1 Kuno, Gwalior State; 1 Gaghjipur, 1 Patan, Mehsana, 1 Ghatwad, South Kathiawar, Gujerat; 2 Meerut, 2 Cawnpore, 1 Bulandshar, U.P.

In series these are more rufous on the underparts than nominate *socialis.* Except in one from Gwalior the rufous rump is distinctive, but this appears again in another from Sankrametta, Eastern Ghats, which is included with nominate *socialis.*

Measurements on p. 154.

1516 **Prinia socialis inglisi** Whistler & Kinnear (Bhutan Duars) Assam Ashy Wren-Warbler

nil.

1517 **Prinia socialis socialis** Sykes (Dukhun) Southern Ashy Wren-Warbler 2: 530

13: 3 ♂♂ (2 fledglings) 7 ♀♀ 3 o? (1 fledgling)

1 Suriamal Ghat, North Thana; 1 Andheri, 1 Goregaon, Bombay; 1 Palagul (?), 2 Karwar, North Kanara; 1 Cooly Ghat, Palnis; 1 Deramalai, Panthalam Hills, 1 Kurumbapatti, Salem; 2 Sankrametta, 1 Jeypore Agency, Vizagapatnam Hills, 1 Bailadila, Bastar, C. I.

Measurements on p. 154.

1518 **Prinia socialis brevicauda** Legge (Ceylon) Ceylon Ashy Wren-Warbler 2: 530

nil.

Prinia sylvatica

Five races are accepted in INDIAN HANDBOOK against three in Stuart Baker and it is difficult to follow a key (vol. 8, p. 62) which requires a determination of the difference or identity of the summer and winter plumage! There is no consistent difference in colour or size and the groupings are made as accepted in INDIAN HANDBOOK on geographical grounds.

1519 **Prinia sylvatica gangetica** (Blyth) (Upper Ganges) Gangetic Jungle Wren-Warbler 2: 532

13: 6 ♂♂ 4 ♀♀ 3 o?

1 Jammu; 3 Kalka, 1 Bhagat State, Simla Hills; 1 Dorazpur, 1 Mubarikpur, Ambala, 1 Chandigarh, Punjab; 1 Delhi; 4 Narwar Fort, Gwalior.

A ♂ dated 4 June has a black bill while two more dated 29 May and 20 July under nominate *sylvatica* have similar bills, indicating it would appear, a breeding condition.

In series, the underparts are more sullied rufous than in any other group. Of the 6 males, 5 winter birds (Dec-March) have their tails 79-93 mm., cf. 74 in one summer (June), leaving the former larger than in any other group.

Measurements on p. 155.

1520 **Prinia sylvatica insignis** (Hume) (Mt. Aboo) Northwestern Jungle Wren-Warbler 2: 533

14: 10 ♂♂ 2 ♀♀ 2 o?

4 **Jaswantpura, Sunda Hills, Jodhpur; 2 **Bhujia Fort, 1 Nakhatrama, 1 Jakhaw, 1 Kutch, 1 Traj, Kaira Dist., 1 Nadiad Town Environs, 2 Dabka, Baroda, 1 Rajpipla Town Environs, Gujerat.

Two each from Jaswantpura, Jodhpur, and Bhujia Fort, are earthy grey above and marked juveniles.

Measurements on p. 155.

1521 **Prinia sylvatica sylvatica** Jerdon (Seegore Ghat, Nilgiris) Peninsular Jungle Wren-Warbler 2: 532 (part)

28: 19 ♂♂ 6 ♀♀ 3 o?

1 Ratlam, C.I.; 1 Bhiwandi, 1 Kalyan, nr. Bombay; 1 Waghotan, Ratnagiri, 1 South Konkan; 1 North Kanara; 1 Aramboli, South Travancore; 1 Kurumbapatti Salem Dist., 3 Seshachalam Hills, 4 Palkonda Hills; 1 Lamasinghi, Vizagapatnam; 1 Arifabad, 1 Utnoor, Hyderabad, 1 Koira, Bonai, Orissa; 3 Melghat, Berar; 1 Daulatabad, 1 Hoshangabad, 3 Jubbulpore; 1 no locality, (collected F.J.R. Field = Bihar?).

In this group almost all have white tips to all but the central tail feathers but this character may well vary with different seasons in different latitudes and it is not possible to take any definite decision. Similar remarks apply to some which appear very rufous above but can be matched in other groups.

Sp. 23025 ♂ dated 20 July 68 from Daulatabad has a curious grey collar on both sides of the upper breast, not unsimilar to that in *Prinia socialis*, almost meeting in the centre.

Measurements on p. 155.

1522 **Prinia sylvatica mahendrae** Koelz (Mahendra Giri, Orissa) Orissa Jungle Wren-Warbler

nil.

1523 **Prinia sylvatica valida** Blyth (Ceylon) Ceylon Jungle Wren-Warbler 2: 533

1 ♀ Labugama, Sri Lanka.

Measurements on p. 155.

1524 **Prinia flaviventris sindiana** Ticehurst (Sukkur, Sind) Sind Yellowbellied Wren-Warbler 2: 529

4: 3 ♂♂ 1 o?

3 Jagadhri, Ambala. 1 Bunni, Ladwa, Karnal Dist., Punjab.

Measurements on p. 155.

1525 **Prinia flaviventris flaviventris** (Delessert) (North Bengal) Assam Yellowbellied Wren-Warbler 2: 528

5: 2 ♂♂ 2 ♀♀ 1 o?

1 Hastanipur, Meerut, U.P., 1 Margherita, 1 Gunyeung, North Cachar, 1 Maymyo, 1 *Prome, Burma.*

The single specimen from Hastanipur, Meerut dt. 23 March 1981 was recorded by Y. M. Rai (JBNHS 79 p. 416) as *Prinia flaviventris* but the heading, presumably by the editors, referred to *P. f. flaviventris.* The single specimen cannot be racially separated with any degree of certainty and the matter requires re-examination with more material.

Measurements on p. 155.

1526 **Prinia criniger striatula** (Hume) (Karachi, Sind) Sind Brown Hill Warbler 2: 520

1 ♂ Ravi Kaur, 3500' about 165 m. S. by W. of Kalat, Baluchistan.

The upperparts are appreciably paler than in the others.

Measurements on p. 155.

1527 **Prinia criniger criniger** (Hodgson) (Nepal) Himalayan Brown Hill Warbler 2: 518

43: 24 ♂♂ 11 ♀♀ 2 o?

1 Malakund, N.W.F.P.; 1 Dunga Gali, Murree Hills, 1 Jholar, Punjab; 3 Patiala State, 2 Keonthal State, 1 Kalka, 17 Simla; 2 Mussorie, 1 Dungari, 1 Karuprayag, 3 Chamoli, Gharwal, 1 Gurna, Almora, U.P., 1 Nepal Valley; 2 Mangdechu, 2 Tama, Central Bhutan, 1 Tashgong, 1 Rongtong, 2 Wamrong, East Bhutan.

Measurements on p. 155/56.

1528 **Prinia criniger assamica** (Stuart Baker) 2: 520

1 ♂ Shillong.

This race is named *catharia* in *Indian Handbook* and in the 2nd edition of Ripley's *Synopsis* (1982). The absence of any topotypical *catharia* and *yunnanensis* prompted us to borrow them from the British Museum (Natural History) and the American Museum of Natural History, New York. The question of the identity of Baker's *assamica* from Shillong with *catharia* has been examined and a note, jointly with Dr. (Mrs.) S. Unnithan (p. 206 *infra*) indicates that it is structurally different from *catharia* and may be *yunnanensis.* However it is thought preferable to leave it under *assamica* until more material is available and the matter definitely decided.

Measurements on p. 155.

EL. **Prinia criniger cooki** (Harington) (Thayetmyo) Harington's Brown Hill Warbler 2: 522

4: 1 ♂ 1 ♀ 2 o?

2 *Taunggyi,* 2 *South Shan States, Burma.*

2 were collected by J. P. Cook and one each by Harington and S. Lightfoot. One of the former marked *cooki* by an earlier worker (Ticehurst?) has a slight rufous wash above and is marked "immature". The one collected by Lightfoot is undated and marked as "*Alcippe nepalensis*" and was registered thereunder. There is no streaking on the upperparts which is washed rufous in all (1 June, 2 August, 1 no date).

In a Complete Checklist of the Birds of the World by R. Howard & Alick Moore, 1980, *catharia* and *cooki* are placed under the species *Prinia polychroa,* while *striatula* stays under *criniger.*

Measurements on p. 155/56.

1529 **Prinia atrogularis atrogularis** (Moore) (Darjeeling) Himalayan Black-throated Hill Warbler 2: 523

7: 3 ♂♂ 2 ♀♀ 2 o?

1 Kurseong, Darjeeling, Bengal; 1 Chunthang, North Sikkim; 1 Gedu, 2 Honka, 1 Chapcha, West, 1* Shamgong, Central Bhutan.

*This obtained on 14 April with enlarged ovaries is in summer plumage but with the black on the chin more extensive than in the two *khasiana* below. Sp. No. 6186 Kurseong, 6000' Darjeeling dated 18 Sept. 1920 (C. M. Inglis) is very rufous above resembling in this respect the two under *khasiana,* but this is possibly due to foxing, and is left here where it geographically belongs.

Measurements on p. 156.

1530 **Prinia atrogularis khasiana** (Godwin-Austen) (Khasia Hills) Assam Black-throated Hill Warbler 2: 524

2: 1 ♂ 1 o?

2 Hungrum, North Cachar.

Both collected in May are in summer plumage, with very rufous upperparts.

Measurements on p. 156.

1531 **Prinia burnesii burnesii** (Blyth) (Indus territories = Sind) Western Longtailed Grass Warbler 2: 430

11: 5 ♂♂ 4 ♀♀ 2 o?

3 Sukkur, Sind; 4 Bahawalpur, 4 Lahore, Punjab.

Two of the four from Lahore are exceptionally grey on the underparts.

Measurements on p. 156.

1532 **Prinia burnesii cineraceus** (Walden) (Dhubri, Lower Bengal) Eastern Longtailed Grass Warbler 2: 431

nil.

EL. **Prinia superciliaris superciliaris** (Anderson) (Momein, Chinese Frontier) 2: 524

1 ♀ *Sintaung, South Shan States*, Burma.

Measurements on p. 156.

1533 **Scotocerca inquieta striata** (Brooks) (Naoshera, Punjab) Streaked Scrub Warbler 2: 501

11: 5 ♂♂ 3 ♀♀ 3 o?

1 *Kuli Burzi, Shiraz;* 1 *Godari-Gichi* 3000', 1 nr. *Hermuk*, 1 *Kidri, near Kain*, 1 *Meshed, Sistan, Iran*; 1 Kumbarising, Kharan, 1 Chatuki, Panjgur, 1 Harboi, 1 Chaman, Baluchistan; 2 Choi, Campbellpur, Punjab.

Measurements on p. 156.

1534 **Graminicola bengalensis bengalensis** Jerdon (Cachar) Large Grass Warbler 2: 433

2 ♀♀

1 Goalpara, 1 Mornai, Assam.

Measurements on p. 156.

1535 **Orthotomus sutorius guzuratus** (Latham) (Guzerat) Indian Tailor Bird 2: 410 (part)

48: 28 ♂♂ 15 ♀♀ 5 o?

1 Multan, 1 Ambala, Punjab; 1 Bahawalpur; 2 Sunda Hills, 1 Hamavas Lake, 1 Jodhpur; 1 Rudramata, Kutch; 1 Dwarka, 1 Nadiad, Kaira dt., 1 Bodeli, Baroda dt., Gujarat; 2 Badrawas, Gwalior; 1 Nasik, 1 Upper Colaba, 2 Colaba, 1 Malabar Hill, 1 Santa Cruz, 1 Bandra, 1 Bombay City; 1 Hog Island; 1 Satara, Maharashtra; 1 Dautawana, Bastar, 1 Lohatter Res. Forest, Kanker, 1 Jabalpore C.P.; 2 Ulavi, Sagar, Mysore; 1 Mercara, Coorg; 1 Begur, Manantoddy, 1 Akkulam, Travancore; 1 Thirthamalai, 4 Kurumbapatti, Salem dt., 1 Seshachalam Hills, 3 Palkonda Hills, S. Cuddapah; 1 Anantgiri, 1 Sankrametta, Vizagapatnam; 1 Barapeda, 1 Chahda, Simlipal Hills, 1 Kaira, Bonai, Orissa; 1 Bulandshahr, 1 Cawnpore, U.P.

22 birds (9 ♂♂ 9 ♀♀ 4 o?) from December to March show a slightly rufous or grey wash on the underparts and appear darker than in the other 26 (18 ♂♂ 7 ♀♀) which show whiter below.

Chick No. 26406 which flew into a room in Bombay City entirely lacks the rufous on the crown, a juvenile character which does not appear to have been referred to before. The dark crescent-shaped spots on the side of the throat visible in both sexes are partly due to the colour of the feather bases, and not entirely to the pigmented skin as implied in footnote in IND. HANDBOOK (1973) 8 p. 82.

Guzuratus average slightly larger than both *patia* and *luteus.*

It is not possible to separate tails into winter and summer sizes, though the longest are in July/August.

Measurements on p. 157.

1536 **Orthotomus sutorius patia** Hodgson (Nepal restricted to Kathmandu) Nepal Tailor Bird 2: 412 (part)

16: 10 ♂♂ 4 ♀♀ 2 o?

2 Rinchingpong, West, 2 Martam, Rongni Valley, 1 Singtam, Teesta Valley, Sikkim; 2 Samchi, West, 2 Tama, Central 2 Deothong, East, 1 Khord, Bhutan; 1 Doyang, Sibsagar dt., 3 Dibrugarh, Assam.

The rufous on the forehead is paler than in *guzuratus.*

Measurements on p. 157.

1537 **Orthotomus sutorius luteus** Ripley (Teza, Mishmi Hills, NE Assam) Mishmi Tailor Bird

5: 2 ♂♂ 2 ♀♀ 1 o?

1 Sadiya, U. Assam, 1 Dening, Lohit Valley, 1 Margherita, Assam; 1 *Wahlong,*? 1 *Prome dt., Burma.*

Measurements on p. 157.

1538 **Orthotomus sutorius sutorius** (Pennant) (Ceylon) Ceylon Tailor Bird 2: 410

nil.

1539 **Orthotomus sutorius fernandonis** Whistler (Ohiya, Ceylon) Ceylon Highland Tailor Bird

nil.

1540 **Orthotomus atrogularis nitidus** Hume (Pahpoon, Tenasserim) Blacknecked Tailor Bird 2: 415

nil.

1541 **Orthotomus cucullatus coronatus** (Blyth) (Sikkim) Goldenheaded Tailor Bird 2: 516

6: 2 ♂♂ 3 ♀♀ 1 o?

Measurements on p. 157.

1542 **Locustella certhiola centralasiae** Sushkin (Khara Usu River Khangai, northwestern Mongolia) Pallas's Central Asian Grasshopper Warbler 2: 399

nil.

1543 **Locustella certhiola rubescens** Blyth (near Calcutta) Pallas's Siberian Grasshopper Warbler 2: 399

1 *Peking, China.*

IND. HANDBOOK and SYNOPSIS accept both races from the Andaman & Nicobar Islands, but there is no reference to the specimens obtained &/or examined.

Measurements on p. 157.

1544 **Locustella lanceolata** (Temminck) (Russia) Streaked Grasshopper Warbler 2: 401

3: 1 ♂ 2 o?

1 Camorta, 1 Nankaury, 1 Trinkut, Central Nicobars.

Measurements on p. 157.

1545 **Locustella naevia straminea** Seebohm (Turkestan) Eastern Grasshopper Warber 2: 402

13: 6 ♂♂ 4 ♀♀ 3 o?

1 Koti State, 2 Simla Hills, N.W. Himalayas; 1 Changalra, Bhuj, Kutch; 1 Hingolgadh, Jasdan, Saurashtra; 2 Golana, Cambay City, Gujarat; 1 Mathar, Narbada Valley, Bhopal; 1 Ghoti, Nasik dt., 1 Kalyan, 2 Thana, Bombay. 1 Panvel, Raigadh.

Measurements on p. 158.

1546 **Schoenicola platyura** (Jerdon) Goodalur, foot of the Neilgheries) Broadtailed Grass Warbler 2: 437

6: 5 ♂♂ 1 o?

4 Muthukuzhi, Ashambu Hills, 1 Peermade, Travancore; 1 Point Calimere, Tamil Nadu.

Unsexed No. 24186 obtained at Pt. Calimere* on 28th Nov. '75, in addition to extending the known range eastwards, has both the upper and lower parts darker brown than in the others, showing less rufous.

* After this was completed Ben King called at the Society and said he had observed this species at 1200 m. elevation in grass near Top Slip in the Anamalai Hills of Tamil Nadu. The bird seen agreed in coloration with the Point Calimere specimen, i.e. the upper parts, sides of the neck and the sides of the breast were a dark chocolate brown, without any reddish tinge. The specimens in the B.N.H.S. collection are, he thought, progressively paler and more rufescent on the upper parts, and the underparts more rufescent the older they are. This suggests that the description in the Handbook is based on faded, "foxed" specimens and does not accurately describe the living bird.

Measurements on p. 158.

1547 **Chaetornis striatus** (Jerdon) (Nilgiris) Bristled Grass Warbler 2: 438

3 ♂♂

2 Ramowli, 1 Anark, Darbhanga, Bihar.

Measurements on p. 158.

1548 **Megalurus palustris toklao** (Blyth) (Calcutta) Striated Marsh Warbler 2: 435

18: 12 ♂♂ 5 ♀♀ 1 o?

a) 1 Machiwara, Ludhiana, Punjab; 4 Benoa, Darbhanga, Bihar; 1 Dibrugarh, 2 Sadiya, Assam; 1 Tarajuli, Arunachal Pradesh; 2 Roopachena, N. Cachar.

b) 2 *U. Burma,* 1 *Maymyo,* 1 *Prome dt.,* 2 *Henzada dt.,* 1 *Hamalin, E. Bank of Chindwin, Burma.*

None of the specimens now (July 1984) available (latest February 1978) have any yellow below. Those from Burma are appreciably larger.

Measurements on p. 158.

1549 **Acrocephalus aedon aedon** (Pallas) (Dauria) Thickbilled Warbler 2: 440

19: 12 ♂♂ 4 ♀♀ 3 o?

1 Bhuj, Kutch; 1 Mercara, Coorg; 1 Parambicolam, Cochin, 1 Peermade, 1 Thattakad, 1 Rajampara, Panthalam Hills, Travancore; 1 Point Calimere, Tamil Nadu; 1 Minumulur, Vizag dt., A.P.; 2 Keonjargorh, Orissa; 1 Dum Dum, Calcutta; 1 Roopachena, Cachar; 1 Long Island, Middle Andamans, 1 Pyinmanala, 17 km. S. of Port Blair, S. Andaman; 1 Narcondam Island; 1 *Sayekain,* 1 *Prome dt.,* 2 *Henzada dt.,* Burma.

There is a slight variation in the colour of the upper parts but only one No. 5725 o? Dum Dum, Calcutta, November 1891 is as pale rufous as the two from Peking i.e. *rufescens* (*infra*). The specimen is in very poor condition and I am for the moment leaving it here.

Measurements on p. 158.

EL. **Acrocephalus aedon rufescens** Stegmann (Amur) Amur Thickbilled Reed Warbler

2: 1♂ 1 ♀ Peking, China.

See footnote on p. 98 Vol. 8 INDIAN HANDBOOK and remarks under 1549 above.

Measurements on p. 158.

1550 **Acrocephalus stentoreus brunnescens** (Jerdon) (Carnatic, near Trichinopoly) Indian Great Reed Warbler 2: 389

31: 17 ♂♂ 9 ♀♀ 5 o?

(a) 1 Kalag-i-Jam, Baluchistan; 1 Pirbalawood, Peshawar, N.W.F.P., 3 Dal Lake, 1 *Banyar, Lower Jhelum, 1 Kashmir; 1 Jagadhri, Ambala dt., Punjab; I Hamavas Lake, Pali dt., Jodhpur; 1 Bharatpur, Rajasthan; 1 Bhachan dt., Kutch, 1 Kharaghoda, 1 Baroda City, Gujarat; 1 Poona; 1 Vembanad Lake, 1 Karupadam, Cochin, 1 Thiruvala, Aleppey dt., Kerala; 1 Mukher, 1 Kandahar, Nander dt., Hyderabad, 1 Bolgafh, Puri dt., 1 Barkul, 1 Bhusanpur, Chilka Lake, Orissa; 1 Baghowni, Tirhut, Bihar; 1 Tal Bhagala, Bahraich, Oudh,
* partial albino.

(b) 1 Nawashahr, Jullundur, Punjab; 2 Hamavas Lake, Pali dt., Jodhpur; 1 Panvel, Kolaba dt., 1 Rewas, across Bombay harbour, 1 Vengurla, Ratnagiri; 1 Karwar, N. Kanara.

On p. 105 of Vol. 8 of IND. HANDBOOK under *Acrocephalus arundinaceus zarudnyi* Hartert, it is stated that *stentoreus* can be separated by the first primary being longer than the primary coverts. This does not apply to either species, and *arundinaceus* also have the 2nd primary shorter than the 4th.

Seven (3 ♂♂ 3 ♀♀ 1 o? Oct. (2), Feb., April & May in group (b) above have a slight rufous wash above and also on the underparts. The last character is missing in ♂ No. 5459 collected at Rewas, Kolaba (now Raigadh) opposite Bombay on 2nd April, which was calling in the mangrove and had enlarged testes.

Two eastern specimens from Dibrugarh, Assam and Pegu, Burma are placed under *amyae* on distributional grounds but no difference is visible.

Measurements on p. 159.

1551 **Acrocephalus stentoreus meridionalis** (Legge) (Jaffna, Ceylon) Ceylon Great Reed Warbler 2: 389

nil.

1552 **Acrocephalus stentoreus amyae** Baker (Hessamara, Assam) Assam Great Reed Warbler 2: 390

3: 2 ♂♂ 1 o?

1 Dibrugarh, Assam; 1 Choldhari, S. Andaman; 1 *Pegu Burma.*

The one from S. Andaman was identified as *amyae* by Dr. Ripley (JBNHS 61.562) but except that the tail is only 65 mm. (as in *meridionalis*) the remarks under 1550 regarding relative lengths of the 2nd and 4th primaries apply here too.

Measurements on p. 159.

1553 **Acrocephalus arundinaceus zarudnyi** Hartert (Djarkent, Turkestan) Eurasian Great Reed Warbler

11: 5 ♂♂ 1 ♀ 5 o?

1 *Darrada,* 1 *Residency,* 1 *New Tigris,* 2 *m. downstream of Baghdad;* 2 *Gardin, Sheikh, Saud,* 4 *River Euphrates, Mesopotamia;* 2 *Kashgar, China.*

The first primary is shorter than the primary coverts and the second longer than the fourth. The tarsus is smaller than indicated in IND. HANDBOOK.

Measurements on p. 159.

EL. **Acrocephalus arundinaceus griseldis** (Haurtlaub) (Tanganyika) Great Reed Warbler

4: 1 ♂ 1 ♀ 2 o?

2 *Gurmat Ali,* 2 *Basra, Iraq.*

The small size separates this from other races of *arundinaceus.*

Measurements on p. 159.

1554 **Acrocephalus orientalis** (Temminck & Schlegel) (Japan) Eastern Great Reed Warbler 2: 391

9: 5 ♂♂ 3 ♀♀ 1 o?

4 Choldari, 1 Port Blair, 1 Corbyn's Cove, S. Andaman; 2 *Kyithe, Prome dt., Burma;* 1 *Peking, China.*

The last three were wrongly identified and registered as *A. stentoreus* and *arundinaceus.*

The first primary is shorter than the primary coverts except in Sp. No. 26038, Corbyn's Cove (6 Feb. 1980) in which it is longer on one side and shorter on the other. The second primary is longer than the 4th except in ♂s 23239 and 23237 from S. Andaman in which the 2nd & 4th are in both equal on one side but longer on the other in one, and shorter in the other specimen.

Measurements on p. 159.

1555 **Acrocephalus bistrigiceps bistrigiceps** Swinhoe (Amoy) Blackbrowed Reed Warbler 2: 392

2: 1 ♂ 1 ♀ *Peking, China.*

A third bird from the same place marked as of this species but without the black brow was identified as *Phylloscopus fuscatus fuscatus* by Dr. B. Biswas.

Measurements on p. 159.

1555a **Acrocephalus scirpaceus fuscus** (Hemprich & Ehrenberg) (Northern Arabia) Reed Warbler

1 ♀ *Engeli, Persia.*

The first primary is larger than the primary coverts *contra* shorter in nominate *scirpaceus.* It is also paler and less rufous, and whiter below.

Christison and Ticehurst in 'Birds of Northern Baluchistan' JBNHS 43 p. 480 referred to this species breeding at Malizai Lora, Northern Baluchistan, but even the specific identification of the specimen obtained is recorded with doubt, while two sets of eggs were lost in the post. Both this and the next species were identified at the British Museum by Mr. Colston.

Measurements on p. 160.

EL. **Acrocephalus scirpaceus scirpaceus** (Hermann) (Alsace) Reed Warbler

1: 1 ♂ *Babylon.*

See remarks under 1555a.

Measurements on p. 160.

1556 **Acrocephalus dumetorum** Blyth (Calcutta) Blyth's Reed Warbler 2: 393

90: 34 ♂♂ 37 ♀♀ 19 o?

1 Harbau, ca. 55m e. of Panjgur, 1 Korac, Pilar, 108 m. sw. of Kalat, Baluchistan; 1 Hyderabad, Sind; 1 Keonthal State, 1 Dharni State, 1 Patiala State, 3 Koti State, 7 Simla, N.W. Himalayas; 2 Bharatpur, Rajasthan; 1 Hamavas Lake, Jodhpur State; 1 Mahal, Surat Dangs; 1 Niphad, Madhmeshwar, Nasik; 1 Khaneri, 1 Mulund Hills, 1 Bandra, 1 Bombay; 1 Poona, 1 Ratnagiri, Maharashtra; 1 Kanta, 1 Bailadila, 1 Golapalli, 1 Bhopalpatnam, C.P.; 2 Molem, Goa; 1 N. Kanara, 3 Ulavi, Sorab Taluka, 3 Murgimatta, Shimoga, 1 Attikan, Billigirirangan Hills, Mysore; 2 Mercara, Coorg; 1 Cherangodu, Cherambadi, 1 Gudalur, Nilgiris; 2 Peermade, 1 Annaimudi High Range, Travancore, 1 Edanad, Chenganur, Alleppy dt., Kerala; 1 Kodaikanal; 1 Cape Comorin, 3 Kurumbapatti, Salem dt., Tamil Nadu; 1 Kala Vaghu, 1 Kodhaludu, Sri Harikota, 4 Nallamalai Range, S. Kurnool, 9 Godaveri Delta, Godaveri Dt., 8 Sankrametta, Vizagapatnam dt., A.P.; 1 Mandasa, 2 Barkul, Chilka Lake, 1 Barkot, Bamra, 1 Berbera, Puri dt., Orissa; 5 Baghownie, Darbhanga, Bihar; 1 Rajaputti, Saran, Bengal, 2 Dibrugarh, Assam.

These have been identified by the olive brown colour above, the small 1st primary, the emarginations on outer webs of 3rd and 4th primary and the notch on the inner web of the 3rd being at a level between the 8th and 10th.

On p. 109 Volume 8 of INDIAN HANDBOOK is a sketch of the wings of four species of *Acrocephalus* where the legend states that it shows difference in the relative lengths of 2nd primary and position of notch on inner web of *this* (i.e. second) primary which is presumably a misprint for *third* as per key on p. 101. No notch is visible in the sketch.

Measurements on p. 160.

1557 **Acrocephalus agricola agricola** (Jerdon) (neighbourhood of Nellore) Indian Paddyfield Warbler 2: 394

28: 13 ♂♂ 9 ♀♀ 6 o?

1 Banyar, Lower Jhelum, Kashmir; 2 Jagadhri, Ambala, Punjab; 1 Harunabad, Bahawalpur; 3 Bharatpur, Rajasthan; 1 Mandvi, Kutch; 1 Cambay City Environs, Gujarat; 1 Santhanwara, Gwalior State; 1 Madhmeshwar, 2 Ghoti, Nasik; 2 Belapur Road, 1 Wada, 2 Thana dt., 1 Murbad, Kalyan, Maharashtra; 1 Pt. Calimere, T.N., 1 Godaveri delta, A.P.; 1 Gondia, 1 Amraoti, 2 Bailadila, Bastar, C.P.; 2 Khandapara, Orissa, 1 Baghowni, Tirhut, Bihar.

Measurements on p. 160.

1558 **Acrocephalus agricola capistrata** (Severtzov) (Turkestan) Northern Paddyfield Warbler 2: 394

I cannot separate any listed under 1557 as of this form.

1559 **Acrocephalus concinens haringtoni** Witherby (Buttakundi, Khagan N.W.F.P.), Kashmir Bluntwinged Warbler 2: 396

1 ♂ Srinagar, Kashmir, collected by T. R. Livesey in June 1921.

The bird is from near the type locality of Whistler's *hokrae* which has been synonymised with this form.

The specimen is in very poor condition and it is not possible to determine the approximate size of the 1st primary, Mr. Colston tells me that the 20 + specimens of *haringtoni* at the British Museum all have a large 1st primary. In INDIAN HANDBOOK 8 p. 100 a small and pointed 1st primary is said to be a character of *Acrocephalus.*

Wing 58, bill 13, tarsus 21.4, tail 63.

1560 **Acrocephalus concinens stevensi** Baker (Hessamara, N. Lakhimpur, Assam) Bluntwinged Paddyfield Warbler 2: 397

nil.

EL. **Acrocephalus concinens concinens** (Swinhoe) (Peking) Bluntwinged Paddyfield Warbler

1 ♂ *Peking, China* (Sp. No. 5535) The 1st primary is larger than the wing coverts. Wing 54, bill 12.3, tarsus 21.5, tail 49.

1561 **Acrocephalus (stentoreus) orinus** Oberholser (Rampoor) Largebilled Reed Warbler 2: 398

nil.

1561a. **Acrocephalus schoenobaenus** (Linnaeus) (Uppsala, Sweden) Sedge Warbler

3: 1 ♂ 2 ♀♀

1 *Basra*, 1 *Sheikh Saud, Iraq;* 1 *Ojair, Arabia.*

This has not yet been included in Indian literature but Horace Alexander (1974) has a sight record for Delhi pp. 225-6 in "70 years of Bird Watching".

Measurements on p. 160.

1562 **Hippolais caligata caligata** (Lichtenstein) (Ilek R., near Orenburg) Siberian Booted Tree Warbler 2: 444

34: 12 ♂♂ 15 ♀♀ 7 o?

2 *Shiraz, Persia;* 1 Quetta, Baluchistan; 1 Ambala, Punjab; 1 Manthar, Bahawalpur State; 1 Bharatpur; 1 Hamavas Lake, Jodhpur State; 1 Chengarla, 1 Nakatrama, 1 Rudramata, Bhuj, Kutch; 2 Jabbalpore, 4 Gondia, 1 Bind, 1 Luthai, Gwalior, C.I., 1 Malad, 2 Juhu, 1 Chembur, Bombay; 1 Anaikatty River area, Gudalur dt. 1 Segoor, R.F., 3500', Nilgiris; 2 Point Calimere, Tamil Nadu; 1 Bhadrachalam, 2 Godavari Delta, 3 Cumbum Valley, Kurnool dt., A.P., 1 Etawah, 1 Bulandshahr, U.P.

Compared to *H. c. rama* these are slightly darker above and have tails 52 mm. or shorter, but the two forms do not appear to be quite certainly separable in every instance.

Measurements on p. 160/61.

1563 **Hippolais caligata rama** (Sykes) (Dukhun) Indian Booted Tree Warbler 2: 442

25: 12 ♂♂ 8 ♀♀ 5 o?

1 *Herat, Afghanistan;* 1 Pithoro, Sind; 1 Multan, Punjab; 1 Jakhan, 1 Bhimsar Tank, Anjar dt., 1 Bhujia Fort, 1 Rudramata, 1 Dholovra, Khander I., Kutch; 1 Palanpur, 2 Vaghjipur, Mehsana dt., 2 Asamli, Kaira dt., 1 Amreli, Kathiawar, 1 Ghatwad, South Kathiawar, 1 Ajwa, Baroda dt., Gujarat; 1 Surwaya, Gwalior State, C.I., 2 Madhmeshwar, 1 Nasik, 1 Satara, Maharashtra; 1 Santa Cruz, near Bombay, 1 Shil, Thana, 2 Point Calimere, Tamil Nadu.

As indicated under 1562 there is some uncertainty regarding the separation of these two forms.

Measurements on p. 160/61.

1564 **Hippolais languida** (Hemprich & Ehrenberg) (Syria) Upcher's Tree Warbler 2: 445

1 ♀ Karrassbab, 212 m. s.w. of Kalat, Baluchistan.

Measurements on p. 161.

1564a. **Sylvia nisoria** (Bechstein) (Kachka Su, Central Tien Shan) Barred Warbler

5: 2 ♂♂ 3 o?

2 *Baghdad*, 2 *Felujah, R. Euphrates*, 1 *Sheik Saud, Mesopotamia.*

Three were taken in April, one each in August and September. The last two have unbarred underparts and the last dt. 11th September is also marked as "very fat." Two of the unsexed birds are darker above than the others.

No subspecies are referred to in IND. HANDBOOK and SYNOPSIS 2nd Ed., but Howard and Moore in A Complete Checklist of the Birds of the World (1980 p. 443) list *S. nisoria merzbacheri* from N. Iran, Afghanistan and C. Asia. Mr. Peter Colston in a recent letter says there are no races.

Measurements on p. 161.

EL. **Hippolais pallida elaeica** Lindermeyer (Greece) Olivaceous Warbler

12: 7 ♂♂ 2 ♀♀ 2 o?

2 *Sheikh Saud*, 1 *Sera, Tigris*, 4 *Basra*, 1 *Fahama, Baghdad, Iraq*, 1 *Gulaheb*, 1 *Legation, Teheran*, 1 *Shiraz, Iran;* 1 *S. Russia.*

The subspecific identification is based on distributional grounds.

Measurements on p. 161.

1565 **Sylvia hortensis jerdoni** (Blyth) (Southern India) Eastern Orphean Warbler 2: 448

19: 5 ♂♂ 10 ♀♀ 4 o?

1 *Shiraz,* 1 *Tanb Island,* Iran; 1 Cherat, N.W.F.P., 1 Sakesar, Shahpur dt., Punjab; 1 Bhujia Fort, Kutch; 1 Vaghjipur, Mehsana dt., 1 Victoria Park, Bhavnagar, 1 Golana, 1 Cambay City, 1 Dabka, 1 Bodeli, 1 Ajwa, Baroda, Gujarat; 1 Guna, Bajrangarh Fort, Gwalior, 1 Rutlam, C.I.; 1 Madhmeshwar, Nasik, 1 Juhu, Salsette, Bombay, 1 Poona, Maharashtra; 1 Mysore, 1 no locality.

The form *balchanica* is accepted from Transcaspia and Iran and it is quite possible that some of the migrants into India are of this form. The absence of material for comparison does not permit any opinion. The unsexed specimen from Bhavnagar (No. 21218, 25 September 1961) is greyer and a very different colour from the others, but Mr. Peter Colston has named it *jerdoni.*

Measurements on p. 161.

EL. **Sylvia hortensis hortensis** (Gmelin) (France & Italy) Orphean Warbler

1 ♂ *Sudfrankreich* (*South France*) *Berlin Museum*

The bill is noticeably smaller (13.3 mm.) than in any of the others of this species.

Measurements on p. 161.

1565a. **Sylvia hortensis crassirostris** (Cretzschmar) (Nubia) Orphean Warbler

nil.

1566 **Sylvia communis icterops** Menetries (Talyeh, Eastern Transcaucasia) Indian Whitethroat 2: 447

17: 6 ♂♂ 9 ♀♀ 2 o?

1 *Shaiba,* 1 *Alasik-Samarra, Balad,* 1 *Fahuma,* 1 *Felujah, Iraq;* 1 *Shiraz,* 1 *Ahwaz, Iran;* 1 Sakesar, Shahpur dt., Punjab; 1 New Delhi, 3 Bhujia Fort, 1 Shidata, 1 Chaugatra, Bhuj, 1 Nakhatrana, Kutch; 1 Dwarka, 1 Hingolgadh, Jasdan, 1 Amreli, Gujarat.

There is some variation in the extent of rufous on the wing coverts and grey on the upperparts. The darkest specimen ♂ No. 20331 from Bhuj, Kutch, obtained on 18th Sept., 1959, was sent to the British Museum (N.H.), where the subspecific identity was confirmed by Mr. Peter Colston.

Measurements on p. 161.

1567 **Sylvia curruca blythi** Ticehurst & Whistler (Cawnpur) The Indian Lesser Whitethroat 2: 451

64: 29 ♂♂ 22 ♀♀ 13 o?

1 *Pahra* nr. *Bampur, Persian Baluchistan;* 1 *Takhoi, Kashgar, China*; 1 Kargil, Ladak; 1 Wana, S. Waziristan; 1 Multan; 1 Kalka, 7 Ambala; 2 Hamavas Pali, Rajasthan; 1 Delhi; 2 Bharatpur; 1 Jajjah, 1 Bahawalnagar, 1 Chachra, 1 Manthar, Cholistan, 1 Bhung, 2 Bahawalpur Town, Bahawalpur, 1 Phulji; Larkana, Sind; 1 Narwar Fort, 1 Gwalior, 1 Ratlam, C.I., 3 Chikalda, Berar; 1 Chobari, 1 Kala Dongar, 1 Rapar, 1 Kuar Bet, Bannu, 1 Wataria, 3 Bhuj, Kutch; 1 Kharaghoda, 1 Hingolgadh, 1 Radhanpur, 1 Vaghjipur, 1 Ajwa, 2 Dabka, 1 Golana, 1 Amreli, Gujarat; 2 Nasik, 2 Andheri, Bombay; 1 Anantgiri, Vizagapatnam; 1 Jabalpur, 1 Gondia, 1 C.P.; 4 Cawnpore, 1 Ghazipur, 2 Ganges Canal, Meerut, U.P.

2nd primary between 6th and 7th.

The above include 3 specimens from Kutch Nos. 5846, (Bhuj, 1939), 5861 (Rapar, 1941) and 20849 (Kuar Bet 1960) which were once marked *minula* but had these identifications withdrawn. No. 5864 (1943) also from Bhuj, Kutch, is the specimen mentioned in the footnote on p. 128 of Vol. 8 of Indian Handbook said by Dr. C. Vaurie to be "possibly *S. minula margelanica* Stolzman". Peter Colston thought it to be probably a 1st year *blythi.* The bill is heavier than in four *margelanica* borrowed from the B. M.

Measurements on p. 162.

1568 **Sylvia curruca halimodendri** Sushkin (lower Irgiz and lower Turgai rivers, southern

Kirhiz steppes) Kirghiz Lesser Whitethroat.

1 ♂ No. 5889 collected by Salim Ali at Phulji, N.W. Railway, Larkana, Sind, on 22nd December 1926 is marked *halimodendri* by ? and was now sent to the B.M. (N.H.), where Peter Colston said that as there was only one available to him he was unable to give the differences (if any) between the wing formulae of this race and *blythi.* "The specimen has a 64 mm. wing and the wing formulae would appear to fit *blythi*". He adds "However it is very sandy above like *minula.* I have looked for similar winter *blythi* but have found nothing comparable. Williamson (1968) says *blythi-minula* intergrades occur".

The bird is also marked by the collector "extremely common in low bushes along banks of dry canal" a habitat suitable for *minula* and different from that for *blythi* as per Ticehurst (Ibis 1922 562). Another BNHS No. 5844 collected a day earlier is placed in *blythi* without comment.

Incidentally, the specimen at the B.M. referred to above and sent to Bombay is from Nur Mohammedi 22 m. N.W. of Chaharbar and not Challarbar as recorded in Indian Handbook 8, p. 128. Our specimen lacks the grey which may be due to fading under different atmospheric conditions.

Measurements on p. 162.

1569 **Sylvia curruca minula** Hume (Bhawulpur) Small Whitethroat 2: 451

16: 6 ♂♂ 6 ♀♀ 4 o?

1 *Nur Mohammedi,* 22m. *N.W. of Chaharbar,* 1 *Magas,* 1 *Putak, Persian Baluchistan;* 1 Choi, 1 Campbellpur, W. Punjab; 2 Manthar, Cholistan, 1 Bhung, 1 Daulatpur, 1 Bahawalpur; 3 Khahi, Pithoro; 1 Johi, Larkana, Sind; 2 Bhuj, 1 Rapar, 1 1960 Kuar Bet, Bannu Kutch.

There has been considerable confusion regarding the occurrence of this form as far south as Kutch. In Birds of Kutch (1945) p. 34 Sálim Ali refers to only one Kutch specimen presumably obtained by him (♀ wing 61, tail 54). Later in Birds of Gujarat (1955, JBNHS 52 p. 758) he says the earlier record was an error and that *minula* had not been taken in Gujarat, Saurashtra and Kutch. In SYNOPSIS (1961) and INDIAN HANDBOOK 1973, no record is quoted but in between Soman (1964, JB 61 p. 184) refers to specimen No. 5864 as possibly *margelanica* and also to three others from Kutch as *minula.* Sp. No. 5864 has already been dealt with under 1567 and two of the older skins No. 5849 collected by Capt. Newnham (about 1903) and G. F. Archer (1939) are presumably referred to. The last two are included above, and it is noticed that Kutch is included in the range of this form in the 2nd edition of the SYNOPSIS (1982).

Measurements on p. 162.

1570 **Sylvia curruca althaea** Hume (S. India) Hume's Lesser Whitethroat 2: 450

15: 6 ♂♂ 2 ♀♀ 7 o?

1 Harboi, Baluchistan; 1 Chitral, N.W.F.P., 2 Dachigam, 1 Kashmir; 2 Leh environs, 2 Kargil, Ladakh; 1 Delhi; 1 Bharatpur, 1 Galkund, Surat Dangs; 1 Antarsante, S.W. Mysore, 1 Mysore; 1 Madras.

No. 24268 (July, Ladakh) has a short bill and is presumably a juvenile (Colston).

Measurements on p. 162.

EL. **Sylvia curruca curruca** (Linnaeus) (Sweden) Lesser Whitethroat

6: 4 ♂♂ 2 ♀♀

1 *N. France;* 1 *Shaiba,* 1 *Sheikh Saud,* 1 *Felujah, R. Euphrates,* 1 *Fahama,* 1 *Baghdad, Mesopotamia.*

Compared with specimens received from the British Museum (N.H.) our series, though of about the same age, has faded brown, showing very little grey above, is less white below and have their bills less consistently black.

Measurements on p. 162.

1571 **Sylvia nana nana** (Hemprich & Ehrenberg) (Sinai) Desert Warbler 2: 449

9: 4 ♂♂ 5 ♀♀

1 *Ab-i-Kahugan*, 44 m. *SE of Khwash, Persian Baluchistan;* 1 *Tirphul, Afghan Boundary;* 1 Shahbaz, Kalat, Baluchistan; 1 Attock, W. Punjab; 1 Manthar, 1 Bhung, Bahawalpur; 1 Mandvi, Kutch; 2 Phalodi, Jodhpur.

5 specimens of *Sylvia curruca* were registered under this species.

Measurements on p. 162.

1571a. **Sylvia mystacea** Menetries (Salyany, lower Kura River, eastern Caucasia) Menetries's Warbler

17: 8 ♂♂ (2 by pl.) 9 ♀♀ (2 by pl.)

1 *Kut*, 2 *Sheikh Saud*, 1 *Zubeir*, 1 *Shaiba*, 5 *Shatt-el-Adhain*, 1 *Basra, Mesopotamia;* 2 *Randa Tanhat*, 2 *near Hafaral Atj, Yemen, Arabia;* 1 *Tanb Island*, 1 *Shiraz, Persia.*

T. J. Roberts (1975) in JBNHS 72: 202/3 records this from Pishin dist. n.e. of Quetta, Pakistan and it is now included in the second edition of Ripley's SYNOPSIS (1982).

Two males without black heads are slightly paler than the females. The Shiraz female (No. 5906) has a dark head and also a greyish back and may be wrongly sexed.

Measurements on p. 162.

EL. **Sylvia atricapilla** (Linnaeus) (Sweden) Blackcap

6: 4 ♂♂ 2 ♀♀

2 *Baghdad*, 1 *Qualet Saleh*, 1 *Sheikh Saud*, 1 *Dohuk*, 1 *Basra, Mesopotamia.*

This has a broad first primary longer than the primary coverts. The female has a rufous head.

Measurements on p. 163.

EL. **Sylvia borin** (Bodd.) (France) Garden Warbler

4: 2 ♂♂ 2 ♀♀ (1 juv.)

1 *Sochi, W. Kannasur, U.S.S.R.;* 2 *Baghdad*, 1 *Qualet Saleh, Mesopotamia.*

This has a fine first primary shorter than primary coverts.

Measurements on p. 163.

1471 **Tesia cyaniventer**

	Wing	*Bill*	*Tarsus*	*Tail*
♂♂ (4)	50, 51, 53, 54	11.7, 12, 12.4, 13.3	21.4, 21.6, 22.4, 23	15, 16, 19, 21
	(IH 47-54	from skull 13-15	22-25	18-20)
♀♀ (6)	44-52 av. 48.5	10.8-13 av. 11.7	20-22.7 av. 21.2	16.8-20 av. 18.4
	(IH 44-50	from skull 13-15	22-25	17-19)
o? (4)	48, 50 (2), 51	13(3) 13.3, 13.6	22.5, 22.7(2), 23	18, 22, —

1472 **Tesia olivea**

♂♂ (3)	48 (2), 50	11.5, 12.7, 12.8	20, 22.7, 23	17, 19, 20
	(IH 47-53	from skull 11-12	21-24	26-29)
♀♀ (5)	45-48 av. 45.8	12-12.8 av. 12.6	20.5-22.7 av. 21.2	16, 17(2), 18
	(IH 45-50	from skull 11-12	21-24	22-26)
o? (4)	45, 48, 49, 51	12.1, 12.2(2), 13	18.7, 20.7, 21.2, 22.7	15, 16, 19(2)

1473 **Tesia castaneocoronata**

♂♂ (3)	47, 49, 52	10, 10.3, 11	20.6, 21.5, 23.7	15 21, 22
	(IH 47-53	from skull 11-12	21-24	26-29)
♀♀ (6)	45-49 av. 47	10-10.3 av. 10.2	19.5-21.7 av. 20.6	20-23 av. 21.3
	(IH 45-50	from skull 11-12	21-24	22-26)
o? (8)	46-52 av. 48.5	9.7-11 av. 10.3	18-20.6 av. 19.7	17-23 av. 20

1474 **Cettia pallidipes pallidipes**

♂ (1)	50	10.5	17.8	42
	(IH 47-55	from skull *c.* 14	19-20	45-52)

1477/78 **Cettia montana** subspp.

♂♂				
1477 *pallida* (3)	56, 57, 58	10.8, 11.7(2)	20, 20.2, 20.4	45, 51, 52
1477 *pallida* (1 moulting)	52	10.6	21.9	20
	(IH ♂♂ *c.* 57	*c.* 14	*c.* 21	50-53)
1478 *fortipes* (9)	50-57	11.6-13 av. 12.1	19.3-23.5 av. 21.6	35-54
	(5 specmens moulting)			(6 tails mltg.)
♀♀				
1477 *pallida* (3)	52, 54 58	11.3, 11.5(2)	19.8, 20.7, 21.7	49, 50, 53
	(IH ♀♀ 56-57	*c.* 14	21-22	*c.* 52
1478 *fortipes* (3)	50*, 54, 54	11.3, 11.5, 11.8	18.1, 18.7, 20	37*, 44, 49
				* mltg.
	(IH ♀♀ 47-56	from skull *c.* 14	20-22	44-53)

1471 Tesia cyaniventer

	Wing	*Bill*	*Tarsus*	*Tail*
♂♂ (4)	50, 51, 53, 54	11.7, 12, 12.4, 13.3	21.4, 21.6, 22.4, 23	15, 16, 19, 21
	(IH 47-54	from skull 13-15	22-25	18-20)
♀♀ (6)	44-52 av. 48.5	10.8-13 av. 11.7	20-22.7 av. 21.2	16.8-20 av. 18.4
	(IH 44-50	from skull 13-15	22-25	17-19)
o? (4)	48, 50 (2), 51	13(3) 13.3, 13.6	22.5, 22.7(2), 23	18, 22, —

1472 Tesia olivea

♂♂ (3)	48 (2), 50	11.5, 12.7, 12.8	20, 22.7, 23	17, 19, 20
	(IH 47-53	from skull 11-12	21-24	26-29)
♀♀ (5)	45-48 av. 45.8	12-12.8 av. 12.6	20.5-22.7 av. 21.2	16, 17(2), 18
	(IH 45-50	from skull 11-12	21-24	22-26)
o? (4)	45, 48, 49, 51	12.1, 12.2(2), 13	18.7, 20.7, 21.2, 22.7	15, 16, 19(2)

1473 Tesia castaneocoronata

♂♂ (3)	47, 49, 52	10, 10.3, 11	20.6, 21.5, 23.7	15 21, 22
	(IH 47-53	from skull 11-12	21-24	26-29)
♀♀ (6)	45-49 av. 47	10-10.3 av. 10.2	19.5-21.7 av. 20.6	20-23 av. 21.3
	(IH 45-50	from skull 11-12	21-24	22-26)
o? (8)	46-52 av. 48.5	9.7-11 av. 10.3	18-20.6 av. 19.7	17-23 av. 20

1474 Cettia pallidipes pallidipes

♂ (1)	50	10.5	17.8	42
	(IH 47-55	from skull *c.* 14	19-20	45-52)

1477/78 Cettia montana subspp.

♂♂				
1477 *pallida* (3)	56, 57, 58	10.8, 11.7(2)	20, 20.2, 20.4	45, 51, 52
1477 *pallida* (1 moulting)	52	10.6	21.9	20
	(IH ♂♂ *c.* 57	*c.* 14	*c.* 21	50-53)
1478 *fortipes* (9)	50-57	11.6-13 av. 12.1	19.3-23.5 av. 21.6	35-54
	(5 specmens moulting)			(6 tails mltg.)
♀♀				
1477 *pallida* (3)	52, 54 58	11.3, 11.5(2)	19.8, 20.7, 21.7	49, 50, 53
	(IH ♀♀ 56-57	*c.* 14	21-22	*c.* 52
1478 *fortipes* (3)	50*, 54, 54	11.3, 11.5, 11.8	18.1, 18.7, 20	37*, 44, 49
				* mltg.
	(IH ♀♀ 47-56	from skull *c.* 14	20-22	44-53)

	Wing	Bill	Tarsus	Tail
1481 Cettia flavolivacea flavolivacea				
♂ (1)	55	11.8	20.5	53
	(IH ♂♂ 53-57	from skull c. 14	22-23	47-57)
o? (1)	56	12	21.4	55
1485/87 Cettia brunnifrons subspp.				
♂♂ 1485 *whistleri* (2)	47, 48	—, 9.6	16.2, 17.7	39 40
	(IH measurements as in 1486)			
1486 *brunnifrons* (5)	42-48 av. 45.6	9.4-10 av. 9.7	16.5-18 av. 17.2	41, 43, 44
	(IH ♂♂ 42-51	from skull 11-12		43-45)
♀♀ 1485 *whistleri* (4)	45(3), 46	9.5, 9.6, 10 (2)	16.3, 17, 17.2, 17.4	34, 38, 40, 49
1486 *brunnifrons* (2)	46, 48	9.5, 10.1	17, 17.3	37, 42
	(IH ♀♀ 43-47	from skull 11-12	18-19	41-47)
1488 Cettia cetti albiventris				
♂♂ (2)	66, 72	12.8, 13.0	20.2, 23.5	63, 68
	(IH ♂♂ 68-73	from feathers 11-12	25-26	52-65)
EL. **Cettia cetti orientalis**				
♂ (1)	65	11.5	21.5	65
♀ (1)	61	12.4	19.3	59
EL. **Cettia squamiceps**				
♂ (1)	54	10.7	16.4	27
1490 Bradypterus thoracicus thoracicus				
o? (1)	57	11.5	18	53
	(IH ♂♂ 50-58 ♀♀ 52-55	from feathers 10-11	18-19	46-53 wing NBK, Ludlow; rest Baker)
1491 Bradypterus major major				
♀ (1)	63	14.7	19	59
	(IH ♂♀ 55-65	from skull c. 18	21-22	59-63)
1493 Bradypterus luteoventris luteoventris				
o? (1)	50	12.5	17.6	53
	(IH ♂♂ 51-54 ♀♀ 49-52	from skull c. 14	c. 19	55-56)

1495 **Lusciniola melanopogon mimicus**

	Wing	Bill	Tarsus	Tail
♂♂ (2)	62, 62	11.4, 11.6	20.6, 21.2	51, 54
	(IH ♂♂ 60-65	from skull *c.* 16	—	54-57)
♀♀ (4)	59(2), 61 (2)	10.6, 10.9, 11.2, 11.5	20, 21.1(2), 21.2	48, 51, 53, 54
	(IH ♀♀ 60-63	from skull *c.* 16	—	49-55)
o? (8)	58-65 av. 61	10.6-12 av. 11.4	19.9-22 av. 21.1	47-55 av. 50.3

1496/97 **Cisticola exilis** subspp.

1496 *erythrocephala* ♂ (1)	47	10.2	18.7	53
	(IH 46-51	from skull 11-12	19	48-56 in winter plumage)
1496 *erythrocephala* ♀ (1)	44	10.2	19.3	51
	(IH 43, 45	from skull 11	—	46, 54)
1497 *tytleri* ♀ (1)	44	11	18.3	36
1497 *tytleri* o? (1)	45	9.8	18.3	53
	(IH ♂♀ 44-47	—	—	25-26 summer; 46-48 winter Baker)

1498/1500a & EL. **Cisticola juncidis** subspp.

♂♂				
1498 *cursitans* (15)	45-53 av. 51	9.6-11 av. 10.3	17.2-19.3 av. 18.4	32-45 av. 39
	(IH 48-55	from skull 10-11	19-20	31-43)
1500 *omalura* (1)	49	10	18.6	38
	(IH 50-58	from skull 12-14	20-21	36-42)
1500a *malaya* (5)	46-52 av. 49	9.6-11.4 av. 10.4	17.6-20.3 av. 19.3	38-43 av. 41
	(IH 45-53	11-12	18-20	30-40)
EL. *neurotica* (1)	51	9.5	19	40
♀♀				
1498 *cursitans* (13)	45-51 av. 48	8.7-10.9 av. 9.8	16.8-20.3 av. 18	32-44 av. 39
	(IH 45-55	from skull 11-12	18-19	29-43)
1499 *salimalii* (3)	45, 46, 48	10.1 (2), 10.5	16.8, 18.7, 19.4	32, 38, 40
	(IH summer 45-49, winter 46-49	11	17-19	summer 33-37, winter 35-40)
1500a *malaya* (3)	47, 48, 49	9.7, 10.6, 10.7	17.6, 18.3, 18.5	38, 40, 42
1498 *cursitans* o? (8)	47-53 av. 50	9.1-10.8 av. 9.9	17.7-20.5 av. 19.1	31-43 av. 37
1500 *omalura* o? (1)	46	10	19.9	37
EL. *neurotica* o? (1)	47	9.9	19.6	34

1481 Cettia flavolivacea flavolivacea

	Wing	*Bill*	*Tarsus*	*Tail*
♂ (1)	55	11.8	20.5	53
	(IH ♂♂ 53-57	from skull *c.* 14	22-23	47-57)
o? (1)	56	12	21.4	55

1485/87 Cettia brunnifrons subspp.

♂♂				
1485 *whistleri* (2)	47, 48	—, 9.6	16.2, 17.7	39 40
	(IH measurements as in 1486)			
1486 *brunnifrons* (5)	42-48 av. 45.6	9.4-10 av. 9.7	16.5-18 av. 17.2	41, 43, 44
	(IH ♂♂ 42-51	from skull 11-12		43-45)
♀♀				
1485 *whistleri* (4)	45(3), 46	9.5, 9.6, 10 (2)	16.3, 17, 17.2, 17.4	34, 38, 40, 49
1486 *brunnifrons* (2)	46, 48	9.5, 10.1	17, 17.3	37, 42
	(IH ♀♀ 43-47	from skull 11-12	18-19	41-47)

1488 Cettia cetti albiventris

♂♂ (2)	66, 72	12.8, 13.0	20.2, 23.5	63, 68
	(IH ♂♂ 68-73	from feathers 11-12	25-26	52-65)

EL. Cettia cetti orientalis

♂ (1)	65	11.5	21.5	65
♀ (1)	61	12.4	19.3	59

EL. Cettia squamiceps

♂ (1)	54	10.7	16.4	27

1490 Bradypterus thoracicus thoracicus

o? (1)	57	11.5	18	53
	(IH ♂♂ 50-58	from feathers 10-11	18-19	46-53
	♀♀ 52-55			wing NBK, Ludlow; rest Baker)

1491 Bradypterus major major

♀ (1)	63	14.7	19	59
	(IH ♂♀ 55-65	from skull *c.* 18	21-22	59-63)

1493 Bradypterus luteoventris luteoventris

o? (1)	50	12.5	17.6	53
	(IH ♂♂ 51-54	from skull *c.* 14	*c.* 19	55-56)
	♀♀ 49-52			

1495 Lusciniola melanopogon mimicus

	Wing	*Bill*	*Tarsus*	*Tail*
♂♂ (2)	62, 62	11.4, 11.6	20.6, 21.2	51, 54
	(IH ♂♂ 60-65	from skull *c.* 16	—	54-57)
♀♀ (4)	59(2), 61 (2)	10.6, 10.9, 11.2, 11.5	20, 21.1(2), 21.2	48, 51, 53, 54
	(IH ♀♀ 60-63	from skull *c.* 16	—	49-55)
o? (8)	58-65 av. 61	10.6-12 av. 11.4	19.9-22 av. 21.1	47-55 av. 50.3

1496/97 Cisticola exilis subspp.

1496 *erythrocephala* ♂ (1)	47	10.2	18.7	53
	(IH 46-51	from skull 11-12	19	48-56 in winter plumage)
1496 *erythrocephala* ♀ (1)	44	10.2	19.3	51
	(IH 43, 45	from skull 11	—	46, 54)
1497 *tytleri* ♀ (1)	44	11	18.3	36
1497 *tytleri* o? (1)	45	9.8	18.3	53
	(IH ♂♀ 44-47	—	—	25-26 summer; 46-48 winter Baker)

1498/1500a & EL. Cisticola juncidis subspp.

♂♂				
1498 *cursitans* (15)	45-53 av. 51	9.6-11 av. 10.3	17.2-19.3 av. 18.4	32-45 av. 39
	(IH 48-55	from skull 10-11	19-20	31-43)
1500 *omalura* (1)	49	10	18.6	38
	(IH 50-58	from skull 12-14	20-21	36-42)
1500a *malaya* (5)	46-52 av. 49	9.6-11.4 av. 10.4	17.6-20.3 av. 19.3	38-43 av. 41
	(IH 45-53	11-12	18-20	30-40)
EL. *neurotica* (1)	51	9.5	19	40
♀♀				
1498 *cursitans* (13)	45-51 av. 48	8.7-10.9 av. 9.8	16.8-20.3 av. 18	32-44 av. 39
	(IH 45-55	from skull 11-12	18-19	29-43)
1499 *salimalii* (3)	45, 46, 48	10.1 (2), 10.5	16.8, 18.7, 19.4	32, 38, 40
	(IH summer 45-49, winter 46-49	11	17-19	summer 33-37, winter 35-40)
1500a *malaya* (3)	47, 48, 49	9.7, 10.6, 10.7	17.6, 18.3, 18.5	38, 40, 42
1498 *cursitans* o? (8)	47-53 av. 50	9.1-10.8 av. 9.9	17.7-20.5 av. 19.1	. 31-43 av. 37
1500 *omalura* o? (1)	46	10	19.9	37
EL. *neurotica* o? (1)	47	9.9	19.6	34

1501 **Prinia rufescens rufescens**

	Wing	*Bill*	*Tarsus*	*Tail*
♂♂ (6)	42-44 av. 43.5	10.5-12.6 av. 11.8	17.7-20.7 av. 19.3	37*-50 av. 45
♀♀ (7)	38-45 av. 41	10.4-11.5 av. 11	16-21.2 av. 18.4	36*-55 av. 45.4
	(IH ♂♀ 43-47	from feathers *c.* 11	*c.* 20	* summer summer 30-47 winter 48-67 (Baker)

1502/1504 **Prinia hodgsonii** subspp.

	Wing	*Bill*	*Tarsus*	*Tail*	
				summer	winter
♂♂					
1502 *rufula* (10)	43-50 av. 47.8	9.1-12.6 av. 10.9	15.6-19.2 av. 17.6	33-48 av. 45 (7 birds, April-July)	56 (2), 59 (3 birds, Nov., Dec., Jan.)
	(IH 17 ♂♂ 42-49	from skull 13-14	*c.* 20 (one)	45-55 (Mar-June)	48-60 av. 53.7
1503 *hodgsonii* (11)	42-52 av. 46.7	10-11.6 av. 11.1	16.8-21.5 av. 18.5	43, 46 49	(8 birds,
	(IH 10 ♂♂ 44-51	from skull 11-13	18-20	(3 birds, Aug. ??)	Nov.-March)
1504 *albogularis* (6)	44-56 av. 48.0	10.7-11.8 av. 11.4	17.3-20 av. 18.4	46-58 - summer & winter)	
	(IH ♂♂ 45-52	from skull 12-13	17-19	46, 49(2), 55 (4 birds, May-Aug.) 45-50	49, 57 (2 birds, Jan., Feb.) 55-57
♀♀					
1502 *rufula* (4)	42(2), 46, 47	9.9, 10, 10.9, 11.7	15.6, 16, 17.8, 21.2	46, 55 (Apr.-July)	47 - (Jan.)
	(IH (2) ♀♀ 43, 48	from skull 13	—	—)	
1503 *hodgsonii* (8)	43-47 av. 45.2	10.6-11.5 av. 10.8	16.6-21.1 av. 18.9	40 (August) —	46-55 av. 50 (7 birds, Sept.-March) 44-55 winter)
	(IH (5) ♀♀ 44-48	from skull 11-13	18-20	39, 40, 44	—
1504 *albogularis* (3)	43, 44, 46	10.5, 11, 11.3	17.2, 17.5, 17.7	(April, May, August)	
	(IH ♀♀ 42-48	from skull 12	17-19	39-50	55 —)

1506 **Prinia buchanani**

♂♂ (16)	49-55 av. 51.8	9.5-10.7 av. 10.4	16.5-20 av. 18.2	40*-53 mltg. (4 April-Oct.)	57-70 av. 62.6 (12 Nov.-March)
	(IH ♂♂ 51-55	from skull 12-14	18-19	53-56	61-70)
♀♀ (6)	47-49 av. 47.3	9.5-11.5 av. 10.6	16.2-20.5 av. 17.3	49 mltg. (Oct.)	60-63 av. 61 (5 Dec.-March)
	(IH ♀♀ 47-51	from skull 12-14	17-19	51-60	68)

1508/09 + EL. **Prinia gracilis** subspp.

	Wing	*Bill*	*Tarsus*	*Tail*
♂♂ 1508 *lepida* (8)	39-44 av. 42.2	8.2-9.1 av. 8.6	14.3-17 av. 15.6	51-73
	(IH ♂♂ 43-46	from skull *c.* 12	17-18	summer winter 59-61 68-72)
1509 *stevensi* (2)	38, 40	8.8, 9.5	15.4, 15.7	51, 57
		(IH measurements as in 1508)		
EL. *irakensis* (5)	40-42 av. 40.8	9.2-10.4 av. 9.8	14.4-16.1 av. 15.3	52-63
♀♀ 1508 *lepida* (2)	40, 41	8.8, 10.2	15.6, 16.1	54, 60
	(IH ♀♀ 40-45	from skull 11-12	17-18	54-56 68-71) summer winter
EL. *irakensis* (2)	39, 41	8.9, 9	16, 16.4	53, 58
1510/14 + EL. Prinia subflava subspp.				
♂♂ 1510 *terricolor* (4) (summer plumage)	46 51, 52 (2)	10.2, 10.3, 11 —	19.6, 20 (2), 21	50*, 52, 55, 56 * mltg.
,, ,, (6) (Nov.-Feb. with long rufous tails)	46-51 av. 49.3	9.3-11 av. 10.5	18.8-21.3 av. 19.8	70-80 av. 73.8
,, ,, (11) (Nov./Dec.)	48-52 av. 49.9	9.4-11 av. 10.6	18.3-21.3 av. 19.9	63-79 av. 71.6
	(IH ♂♂ 47-54	from skull 12-13	19-21	summer winter 48-56 59-85)
♂♂ 1511 *inornata* (2) (summer)	48, 50	10.5, 11	18, 19.5	51, 54
1511 *inornata* (4) (long rufous tail Nov-Feb)	45, 49, 50, 51	10.4(2), 10.6, 11.3	18.8, 20, 20.3, 21.1	64, 67, 68 (2
1511 *inornata* (11) (rufous wash & long tails. Nov-Dec)	45-51 av. 48.2	9.9-11.5 av. 10.6	18-21.3 av. 19.6	59-68 av. 63.5
1511 *inornata* (4) (pre-summer)	45, 48 (3)	10.3, 11.3, 12, —	19, 19.2, 19.5, 20.2	53, 58, 64(2)
	(IH ♂♂ 46-54	from skull 12-14	18-20	summer 48-57 winter 53-80)

1501 **Prinia rufescens rufescens**

	Wing	*Bill*	*Tarsus*	*Tail*
♂♂ (6)	42-44 av. 43.5	10.5-12.6 av. 11.8	17.7-20.7 av. 19.3	37*-50 av. 45
♀♀ (7)	38-45 av. 41	10.4-11.5 av. 11	16-21.2 av. 18.4	36*-55 av. 45.4
	(IH ♂♀ 43-47	from feathers *c.* 11	*c.* 20	* summer summer 30-47 winter 48-67 (Baker)

1502/1504 **Prinia hodgsonii** subspp.

	Wing	*Bill*	*Tarsus*	*Tail*	
				summer	winter
♂♂ 1502 *rufula* (10)	43-50 av. 47.8	9.1-12.6 av. 10.9	15.6-19.2 av. 17.6	33-48 av. 45 (7 birds, April-July)	56 (2), 59 (3 birds, Nov., Dec., Jan.)
	(IH 17 ♂♂ 42-49	from skull 13-14	*c.* 20 (one)	45-55 (Mar-June)	48-60 av. 53.7
1503 *hodgsonii* (11)	42-52 av. 46.7	10-11.6 av. 11.1	16.8-21.5 av. 18.5	43, 46 49	(8 birds,
	(IH 10 ♂♂ 44-51	from skull 11-13	18-20	(3 birds, Aug. ??)	Nov.-March)
1504 *albogularis* (6)	44-56 av. 48.0	10.7-11.8 av. 11.4	17.3-20 av. 18.4	46-58 - summer & winter)	
	(IH ♂♂ 45-52	from skull 12-13	17-19	46, 49(2), 55 (4 birds, May-Aug.) 45-50	49, 57 (2 birds, Jan., Feb.) 55-57
♀♀ 1502 *rufula* (4)	42(2), 46, 47	9.9, 10, 10.9, 11.7	15.6, 16, 17.8, 21.2	46, 55 (Apr.-July)	47 - (Jan.)
	(IH (2) ♀♀ 43, 48	from skull 13	—	—)	
1503 *hodgsonii* (8)	43-47 av. 45.2	10.6-11.5 av. 10.8	16.6-21.1 av. 18.9	40 (August) —	46-55 av. 50 (7 birds, Sept.-March) 44-55 winter)
	(IH (5) ♀♀ 44-48	from skull 11-13	18-20	39, 40, 44	—
1504 *albogularis* (3)	43, 44, 46	10.5, 11, 11.3	17.2, 17.5, 17.7	(April, May,	
	(IH ♀♀ 42-48	from skull 12	17-19	August) 39-50	55 —)

1506 **Prinia buchanani**

♂♂ (16)	49-55 av. 51.8	9.5-10.7 av. 10.4	16.5-20 av. 18.2	40*-53 mltg.	57-70 av. 62.6 (12 Nov.-March)
	(IH ♂♂ 51-55	from skull 12-14	18-19	(4 April-Oct.) 53-56	61-70) 60-63 av. 61
♀♀ (6)	47-49 av. 47.3	9.5-11.5 av. 10.6	16.2-20.5 av. 17.3	49 mltg. (Oct.)	(5 Dec.-March)
	(IH ♀♀ 47-51	from skull 12-14	17-19	51-60	68)

1508/09 + EL. **Prinia gracilis** subspp.

	Wing	*Bill*	*Tarsus*		*Tail*	
♂♂ 1508 *lepida* (8)	39-44 av. 42.2	8.2-9.1 av. 8.6	14.3-17 av. 15.6	summer	51-73	winter
	(IH ♂♂ 43-46	from skull *c.* 12	17-18	59-61		68-72)
1509 *stevensi* (2)	38, 40	8.8, 9.5	15.4, 15.7		51, 57	
		(IH measurements as in 1508)				
EL. *irakensis* (5)	40-42 av. 40.8	9.2-10.4 av. 9.8	14.4-16.1 av. 15.3		52-63	
♀♀ 1508 *lepida* (2)	40, 41	8.8, 10.2	15.6, 16.1		54, 60	
	(IH ♀♀ 40-45	from skull 11-12	17-18	54-56 summer		68-71) winter
EL. *irakensis* (2)	39, 41	8.9, 9	16, 16.4		53, 58	

1510/14 + EL. **Prinia subflava** subspp.

♂♂ 1510 *terricolor* (4) (summer plumage)	46 51, 52 (2)	10.2, 10.3, 11 —	19.6, 20 (2), 21		50*, 52, 55, 56 * mltg.	
„ „ (6) (Nov.-Feb. with long rufous tails)	46-51 av. 49.3	9.3-11 av. 10.5	18.8-21.3 av. 19.8		70-80 av. 73.8	
„ „ (11) (Nov./Dec.)	48-52 av. 49.9	9.4-11 av. 10.6	18.3-21.3 av. 19.9		63-79 av. 71.6	
	(IH ♂♂ 47-54	from skull 12-13	19-21	summer 48-56		winter 59-85)
♂♂ 1511 *inornata* (2) (summer)	48, 50	10.5, 11	18, 19.5		51, 54	
1511 *inornata* (4) (long rufous tail Nov-Feb)	45, 49, 50, 51	10.4(2), 10.6, 11.3	18.8, 20, 20.3, 21.1		64, 67, 68 (2	
1511 *inornata* (11) (rufous wash & long tails. Nov-Dec)	45-51 av. 48.2	9.9-11.5 av. 10.6	18-21.3 av. 19.6		59-68 av. 63.5	
1511 *inornata* (4) (pre-summer)	45, 48 (3)	10.3, 11.3, 12, —	19, 19.2, 19.5, 20.2		53, 58, 64(2)	
	(IH ♂♂ 46-54	from skull 12-14	18-20		summer 48-57 winter 53-80)	

1510/14 + EL **Prinia subflava** subspp. (contd.)

	Wing	*Bill*	*Tarsus*	*Tail*
1512 *fusca* (1) (Feb)	47 (IH ♂♂ 47-52	11.7 from skull 13-14	19 —	60 66-87 winter)
1513 *franklinii* (3) (Jan/Feb)	48, 51, 52 (IH ♂♂ 47-55	10.5, 10.9, 11.8 from skull 13-14	18.8,18.9, 21.2 —	58, 62, 67 summer 53)
EL. *burmanica* (2)	49, 50	11.7, 12.4	19.7, 20.1	57, 72
♀♀				
1510 *terricolor* (1) (summer)	48	11	19.6	41
1510 *terricolor* (3) (Nov/Dec)	42, 45, 47	9.8, 10, 11	18.5, 19, 21.2	64, 66, 71
1510 *terricolor* (3) (Feb/March)	45, 46, 48 (IH ♀♀ 48-50	9.6, 9.8, 10.3 from skull 12-13	17, 18.8, 20.5 19-21	50, 64, 74 winter 64-75 winter)
♀♀				
1511 *inornata* (2) (summer)	42, 44	9.1, 10	18.8, 20.5	50, 53
1511 *inornata* (5) long rufous tail (Nov.-Feb.)	40-48 av. 44.6 (IH 45-51	10.3-11.7 av. 10.8 from skull 12-13	18.6-19.8 av. 19.2 *c.* 19	52-71 av. 59.2 summer 49-57 winter 69-74)
1513 *franklinii* (1)	47 (IH 46-49	11 from skull 13-14	18.8 —	47 summer 50, 51 winter 57-63)
EL. *burmanica* (3)	46, 48, 49	11.2, 12.2, 12.5	18.6, 20.1, 21.4	53, 59, 61

1515/18 **Prinia socialis** subspp.

	Wing	*Bill*	*Tarsus*	*Tail*
♂♂				winter 63-78 av. 68.6
1515 *stewarti* (13)	46-51 av. 48.3 (IH ♂♂ 47-52	10-11.9 av. 11.2 from skull 13-15	16.4-21.6 av. 19.3 20-21	summer 52 (1) 50-54 67-80)
1517 *socialis* (1)	44 (IH ♂♂ 45-53)	11.4 from skull 13-15	20 19-21	64 60-65 55-56)
♀♀				
1515 *stewarti* (4)	43, 47 48, 52 (IH ♀♀ 45-58	11.2, 11.5, 11.6, 11.8 from skull 13-15	17.7, 18.3, 19.3, 21 *c.* 20	54, 64, 76, 78 59-64 *c.* 52)
1517 *socialis* (7)	43-49 av. 45.5 (IH ♀♀ 45-47	11.7-12.5 av. 19.9 from skull 13-14	17.2-21.9 av. 19.2 19-20	52-67 av. 59.6 *c.* 55 —)

1519/23 **Prinia sylvatica** subspp.

	Wing	Bill	Tarsus	Tail
♂♂				
1519 *gangetica* (6)	51-64 av. 59.2	10.1-13.3 av. 12.2	18.8-24.6 av. 22.3	74-93 av. 82
	(IH as in 1520)			
1520 *insignis* (9)	52-65 av. 58	10-13.4 av. 11.8	20.5-23.8 av. 22.2	62-88 av. 74
	(IH 59-67	from skull 15-17	23-25	73-95)
1521 *sylvatica* (18)	50-61 av. 56.8	10-13.3 av. 12.1	19.1-24.6 av. 22.5	61-82 av. 65
				winter av. 72.4
	IH 52-65	from skull 14-16	21-24	65-72 summer
				67-79 winter)
♀♀				
1519 *gangetica* (4)	54-65 av. 57	11-12.2 av.. 11.5	19.2-20.3 av. 19.7	73-83 av. 78
	(IH as in 1520)			
1520 *insignis* (2)	54, 55	11.9, 12.5	19.5, 22.7	77, —
	(IH 53-61	from skull *c.* 15	22-25	71-77 winter)
1521 *sylvatica* (5)	52-62 av. 57	13, 13.2, 13.6, —	20.4-25 av. 22.3	56-85 av. 70
	(IH 50-54	from skull 13-14	20-21	57-65)
1523 *valida* (1)	55	—	19.5	58
	(IH 1 ♀ 55	from skull 15	23	55

1524/25 **Prinia flaviventris** subspp.

	Wing	Bill	Tarsus	Tail
1524 *sindiana* (3)	42, 48, 48	11, 11 11.5	16.6, 17, 20.7	53+, 54, 67
	(♂♀ 43.45	from feathers *c.* 10	—	48-64 Baker)
♂♂				
1525 *flaviventris* (2)	42, 49	11.7, 11.8	17.4, 22	52, 69
	(♂♀ 42-49	from feathers 10-11	*c.* 21	50 (summer) to 70 (winter)
♀♀				
1525 *flaviventris* (2)	43, 47	12.1, —	19.3, 20.7	55, 70

1526/28 + EL. **Prinia criniger** subspp.

	Wing	Bill	Tarsus	Tail
♂♂				
1526 *striatula* (1)	59	11.6	20.1	96
	(IH measurements as in 1527)			
1527 *criniger* (23)	54-59 av. 56.6	9.6-11.4 av. 10.6	18-23.1 av. 20.5	winter (6) 80-87 av. 82 summer (17) 74-116 av. 97
	(IH 51-61	from skull 14-15	*c.* 23	90 summer-114 winter)
1528 *assamica* (1)	55	10.4	22	77
	(IH measurements as in 1527)			
EL. *cooki* (1)	51	11.3	22	71

1510/14 + EL **Prinia subflava** subspp. (contd.)

	Wing	*Bill*	*Tarsus*	*Tail*
1512 *fusca* (1) (Feb)	47	11.7	19	60
	(IH ♂♂ 47-52	from skull 13-14	—	66-87 winter)
1513 *franklinii* (3) (Jan/Feb)	48, 51, 52	10.5, 10.9, 11.8	18.8,18.9, 21.2	58, 62, 67
	(IH ♂♂ 47-55	from skull 13-14	—	summer 53)
EL. *burmanica* (2)	49, 50	11.7, 12.4	19.7, 20.1	57, 72
♀♀				
1510 *terricolor* (1) (summer)	48	11	19.6	41
1510 *terricolor* (3) (Nov/Dec)	42, 45, 47	9.8, 10, 11	18.5, 19. 21.2	64, 66, 71
1510 *terricolor* (3) (Feb/March)	45, 46, 48	9.6, 9.8, 10.3	17, 18.8, 20.5	50, 64, 74 winter
	(IH ♀♀ 48-50	from skull 12-13	19-21	64-75 winter)
♀♀				
1511 *inornata* (2) (summer)	42. 44	9.1, 10	18.8, 20.5	50, 53
1511 *inornata* (5) long rufous tail (Nov.-Feb.)	40-48 av. 44.6	10.3-11.7 av. 10.8	18.6-19.8 av. 19.2	52-71 av. 59.2
	(IH 45-51	from skull 12-13	*c.* 19	summer 49-57 winter 69-74)
1513 *franklinii* (1)	47	11	18.8	47
	(IH 46-49	from skull 13-14	—	summer 50, 51 winter 57-63)
EL. *burmanica* (3)	46, 48, 49	11.2, 12.2, 12.5	18.6, 20.1, 21.4	53, 59, 61

1515/18 **Prinia socialis** subspp.

	Wing	*Bill*	*Tarsus*	*Tail*
♂♂				winter 63-78 av. 68.6
1515 *stewarti* (13)	46-51 av. 48.3	10-11.9 av. 11.2	16.4-21.6 av. 19.3	summer 52 (1)
	(IH ♂♂ 47-52	from skull 13-15	20-21	50-54 67-80)
1517 *socialis* (1)	44	11.4	20	64
	(IH ♂♂ 45-53)	from skull 13-15	19-21	60-65 55-56)
♀♀				
1515 *stewarti* (4)	43, 47 48, 52	11.2, 11.5, 11.6, 11.8	17.7, 18.3, 19.3, 21	54, 64, 76, 78
	(IH ♀♀ 45-58	from skull 13-15	*c.* 20	59-64 *c.* 52)
1517 *socialis* (7)	43-49 av. 45.5	11.7-12.5 av. 19.9	17.2-21.9 av. 19.2	52-67 av. 59.6
	(IH ♀♀ 45-47	from skull 13-14	19-20	*c.* 55 —)

1519/23 **Prinia sylvatica** subspp.

	Wing	*Bill*	*Tarsus*	*Tail*
♂♂				
1519 *gangetica* (6)	51-64 av. 59.2	10.1-13.3 av. 12.2	18.8-24.6 av. 22.3	74-93 av. 82
	(IH as in 1520)			
1520 *insignis* (9)	52-65 av. 58	10-13.4 av. 11.8	20.5-23.8 av. 22.2	62-88 av. 74
	(IH 59-67	from skull 15-17	23-25	73-95)
1521 *sylvatica* (18)	50-61 av. 56.8	10-13.3 av. 12.1	19.1-24.6 av. 22.5	61-82 av. 65 winter av. 72.4
	IH 52-65	from skull 14-16	21-24	65-72 summer 67-79 winter)
♀♀				
1519 *gangetica* (4)	54-65 av. 57	11-12.2 av.. 11.5	19.2-20.3 av. 19.7	73-83 av. 78
	(IH as in 1520)			
1520 *insignis* (2)	54. 55	11.9, 12.5	19.5, 22.7	77, —
	(IH 53-61	from skull *c.* 15	22-25	71-77 winter)
1521 *sylvatica* (5)	52-62 av. 57	13, 13.2, 13.6, —	20.4-25 av. 22.3	56-85 av. 70
	(IH 50-54	from skull 13-14	20-21	57-65)
1523 *valida* (1)	55	—	19.5	58
	(IH 1 ♀ 55	from skull 15	23	55

1524/25 **Prinia flaviventris** subspp.

	Wing	*Bill*	*Tarsus*	*Tail*
1524 *sindiana* (3)	42, 48, 48	11, 11 11.5	16.6, 17, 20.7	53+, 54, 67
	(♂♀ 43.45	from feathers *c.* 10	—	48-64 Baker)
♂♂				
1525 *flaviventris* (2)	42, 49	11.7, 11.8	17.4, 22	52, 69
	(♂♀ 42-49	from feathers 10-11	*c.* 21	50 (summer) to 70 (winter)
♀♀				
1525 *flaviventris* (2)	43, 47	12.1, —	19.3, 20.7	55, 70

1526/28 + EL. **Prinia criniger** subspp.

	Wing	*Bill*	*Tarsus*	*Tail*
♂♂				
1526 *striatula* (1)	59	11.6	20.1	96
	(IH measurements as in 1527)			
1527 *criniger* (23)	54-59 av. 56.6	9.6-11.4 av. 10.6	18-23.1 av. 20.5	winter (6) 80-87 av. 82 summer (17) 74-116 av. 97
	(IH 51-61	from skull 14-15	*c.* 23	90 summer-114 winter)
1528 *assamica* (1)	55	10.4	22	77
	(IH measurements as in 1527)			
EL. *cooki* (1)	51	11.3	22	71

1526/28 + EL. **Prinia criniger** subspp. (contd.)

	Wing	*Bill*	*Tarsus*	*Tail*
♀♀				
1527 *criniger* (11)	42-52 av. 47	9.7-10.8 av. 10.1	16.1-20.8 av. 18.3	winter (5) 76-84 av. 81
	″			summer (6) 56-73 av. 65.8
	(IH ♀♀ 51-61	from skull 14-15	*c.* 23	74-84 summer)
EL. *cooki* (1)	48	11.2	18.4	65 summer
1529/30 Prinia atrogularis subspp.				
♂♂				
1529 *atrogularis* (3)	46, 50, 50	10.3, 10.5, 11.7	18.4, 20, 21.6	81, 102, —
	(IH ♂♀ 45-56	from skull 13-15	20-25	75-117)
1530 *khasiana* (1)	45	11.7	18.2	88
	(IH measurements as in 1529)			
♀♀				
1529 *atrogularis* (2)	46, 47	11.3, 12	15.6, 22	—, 94
1531 Prinia burnesii burnesii				
♂♂ (5)	53-55 av. 53.8	10.3-11.1 av. 10.8	19-21.3 av. 20.1	93-108 av. 102
♀♀ (4)	52, 53, 54, 55	10.2, 10.6, 11, —	17.4, 17.7, 19.2, 20	87, 98, 103, 105
o? (2)	53, 54	10.6, 12.5	18.2, 19.6	99, 100
	(♂♀ 53-57	10-11	20-21	85-108 Baker)
EL. Prinia superciliaris superciliaris				
♀ (1)	47	14.5	21.6	91
1533 Scotocerca inquieta striata				
♂♂ (5)	47-51 av. 49.2	10-11.2 av. 10.6	16.7-18.3 av. 17.7	47-51 av. 48.4
♀♀ (3)	45, 46, 46	7.8, 8.7, 10.5	17.5, 18, 18.3	43, 44, 50
	(♂♀ 49-52	—	*c.* 18	43-50 Baker)
o? (3)	50, 52, 54	10, 10, —	16, 17.6, 18	50, 51, 51
1534 Graminicola bengalensis bengalensis				
♀♀ (2)	59, 61	13.1, 13.3	21.1, 22.7	76, 81
	(♂♀ 58-63	13-15	*c.* 24	73-90 Baker)

1535/37 **Orthotomus sutorius** subspp.

	Wing	*Bill*	*Tarsus*	*Tail*
♂♂				
1535 *guzuratus* (28)	44-52 av. 48	12.4-15.5 av. 13.8	18.1-22 av. 19.7	37 (July)-92 (July)
	(IH ♂♂ 47-55	from skull 15-17	17-21	37 (summer)-110 (winter)
1536 *patia* (10)	38-48 av. 44.9	12.7-13.4 av. 13	18.1-20.4 av. 19.5	32 (Nov.)-56 (March)
	(IH ♂♂ 45-50	from skull 15-16	—	43 (summer)-69 (winter)
1537 *luteus* (2)	41, 44	12.9, 13.2	15.9, 18.6	32, 47
	(IH measurements as in 1536)			
♀♀				
1535 *guzuratus* (15)	41-50 av. 45.9	11-14.6 av. 13.5	15.6-20.8 av. 18.9	34 (Dec.)-47 (Jan.)
	(IH ♀♀ 43-49	from skull 14-17	18-21	34-39)
1536 *patia* (4)	41, 43, 44, 45	12.2, 12.6, 12.7, 13.6	15.9, 20, 20, 20.2	31, 37, 38, 43
	(IH ♀♀ 44-50	from skull 15-16	—	37-41)
1537 *luteus* (2)	41, 43	12.5, —	20, 21	34, 37
	(IH measurements as in 1536)			

1541 **Orthotomus cucullatus coronatus**

♂♂ (2)	45, 45	14, 14.4	16.9, 18.3	42, —
	(7 ♂♂ 46-48	from skull 16-18	*c.* 20	34-41)
				(Stresemann, Baker, SA)
♀♀ (3)	43 (2), 44	14.2, 14.8(2)	16.9, 18.3, 18.7	41(3)
	(5 ♀♀ 45-46	from skull 16-18	19-20	*c.* 42)
o? (1)	46	14.1	16.3	43

1543 **Locustella certhiola rubescens**

o? (1)	65	11.5	18.5	51
	(♂♀ 58-71			48-56 Williamson)

1544 **Locustella lanceolata**

♂♂ (1)	52	10.6	18	40
	(IH 6 ♂♂ 53-59	—	—	44-47)
♀♀ (1)	53	10.6	18.4	42
	(IH 4 ♀♀ 52-58	—	—	—)

1526/28 + EL. **Prinia criniger** subspp. (contd.)

	Wing	*Bill*	*Tarsus*	*Tail*
♀♀				
1527 *criniger* (11)	42-52 av. 47 ,,	9.7-10.8 av. 10.1	16.1-20.8 av. 18.3	winter (5) 76-84 av. 81 summer (6) 56-73 av. 65.8
	(IH ♀♀ 51-61	from skull 14-15	c. 23	74-84 summer)
EL. *cooki* (1)	48	11.2	18.4	65 summer

1529/30 **Prinia atrogularis** subspp.

	Wing	*Bill*	*Tarsus*	*Tail*
♂♂				
1529 *atrogularis* (3)	46, 50, 50 (IH ♂♀ 45-56	10.3, 10.5, 11.7 from skull 13-15	18.4, 20, 21.6 20-25	81, 102, — 75-117)
1530 *khasiana* (1)	45 (IH measurements as in 1529)	11.7	18.2	88
♀♀				
1529 *atrogularis* (2)	46, 47	11.3, 12	15.6, 22	—, 94

1531 **Prinia burnesii burnesii**

	Wing	*Bill*	*Tarsus*	*Tail*
♂♂ (5)	53-55 av. 53.8	10.3-11.1 av. 10.8	19-21.3 av. 20.1	93-108 av. 102
♀♀ (4)	52, 53, 54, 55	10.2, 10.6, 11, —	17.4, 17.7, 19.2, 20	87, 98, 103, 105
o? (2)	53, 54	10.6, 12.5	18.2, 19.6	99, 100
	(♂♀ 53-57	10-11	20-21	85-108 Baker)

EL. **Prinia superciliaris superciliaris**

	Wing	*Bill*	*Tarsus*	*Tail*
♀ (1)	47	14.5	21.6	91

1533 **Scotocerca inquieta striata**

	Wing	*Bill*	*Tarsus*	*Tail*
♂♂ (5)	47-51 av. 49.2	10-11.2 av. 10.6	16.7-18.3 av. 17.7	47-51 av. 48.4
♀♀ (3)	45, 46, 46	7.8, 8.7, 10.5	17.5, 18, 18.3	43, 44, 50
	(♂♀ 49-52	—	c. 18	43-50 Baker)
o? (3)	50, 52, 54	10, 10, —	16, 17.6, 18	50, 51, 51

1534 **Graminicola bengalensis bengalensis**

	Wing	*Bill*	*Tarsus*	*Tail*
♀♀ (2)	59, 61	13.1, 13.3	21.1, 22.7	76, 81
	(♂♀ 58-63	13-15	c. 24	73-90 Baker)

1535/37 **Orthotomus sutorius** subspp.

	Wing	*Bill*	*Tarsus*	*Tail*
♂♂				
1535 *guzuratus* (28)	44-52 av. 48 (IH ♂♂ 47-55	12.4-15.5 av. 13.8 from skull 15-17	18.1-22 av. 19.7 17-21	37 (July)-92 (July) 37 (summer)-110 (winter)
1536 *patia* (10)	38-48 av. 44.9 (IH ♂♂ 45-50	12.7-13.4 av. 13 from skull 15-16	18.1-20.4 av. 19.5 —	32 (Nov.)-56 (March) 43 (summer)-69 (winter)
1537 *luteus* (2)	41, 44 (IH measurements as in 1536)	12.9, 13.2	15.9, 18.6	32, 47
♀♀				
1535 *guzuratus* (15)	41-50 av. 45.9 (IH ♀♀ 43-49	11-14.6 av. 13.5 from skull 14-17	15.6-20.8 av. 18.9 18-21	34 (Dec.)-47 (Jan.) 34-39)
1536 *patia* (4)	41, 43, 44, 45 (IH ♀♀ 44-50	12.2, 12.6, 12.7, 13.6 from skull 15-16	15.9, 20, 20, 20.2 —	31, 37, 38, 43 37-41)
1537 *luteus* (2)	41, 43 (IH measurements as in 1536)	12.5, —	20, 21	34, 37

1541 **Orthotomus cucullatus coronatus**

	Wing	*Bill*	*Tarsus*	*Tail*
♂♂ (2)	45, 45 (7 ♂♂ 46-48	14, 14.4 from skull 16-18	16.9, 18.3 c. 20	42, — 34-41) (Stresemann, Baker, SA)
♀♀ (3)	43 (2), 44 (5 ♀♀ 45-46	14.2, 14.8(2) from skull 16-18	16.9, 18.3, 18.7 19-20	41(3) c. 42)
o? (1)	46	14.1	16.3	43

1543 **Locustella certhiola rubescens**

	Wing	*Bill*	*Tarsus*	*Tail*
o? (1)	65	11.5	18.5	51
	(♂♀ 58-71			48-56 Williamson)

1544 **Locustella lanceolata**

	Wing	*Bill*	*Tarsus*	*Tail*
♂♂ (1)	52 (IH 6 ♂♂ 53-59	10.6 —	18 —	40 44-47)
♀♀ (1)	53 (IH 4 ♀♀ 52-58	10.6 —	18.4 —	42 —)

1545 **Locustella naevia straminea**

	Wing	*Bill*	*Tarsus*	*Tail*
♂♂ (6)	55-58 av. 56.2	9-11 av. 10.3	16.2-19 av. 17.6	49-53 av. 50.8
	(IH ♂♂ 53-62	from skull 13-14	18-19	48-61)
♀♀ (4)	54, 55(2), 56	10.1, 11.4, 12(2)	15.2, 16, 18.2, 18.8	45, 48, 50
	(IH ♀♀ 50-57	from skull 13-14	18-19	48-55)
o? (3)	52, 54, 56	10.7, 11.7, 12.3	16.5, 17.8, 18	47, 48, —

1546 **Schoenicola platyura**

♂♂ (5)	56-65 av. 63.2	11.1-13 av. 11.7	20-22 av. 20.8	58-69 av. 62
	(IH ♂♂ 64-72	from skull 13-16	21-23	65-73)
o? (1)	64	11	21.8	64
	(IH ♀♀ 63-67	from skull 13-15	21-22	61-66)

1547 **Chaetornis striatus**

♂♂ (3)	87, 88, 92	10, 12.4, 12.5	28.5, 29, 30.5	88, 89, 90
	(♂♀ 80-92	from feathers *c.* 12	*c.* 28	75-95 Baker)

1548 **Megalurus palustris toklao**

♂♂ (6)	82-99 av. 91.3	14.8-17.2 av. 15.7	30.6-34.5 av. 31.9	102-123 av. 112.8
	(♂♂ 100-137	from feathers 18-19	39	115-134 Baker)
♂♂ (6) (from Burma)	89-106 av. 97	16.4-17.1 av. 16.6	30.1-36.4 av. 34.5	108-152 av. 122
♀♀ (4)	94-98 av. 95.5	16-16.1 av. 16.03	33.6-35.2 av. 34.4	102-119 av. 111.7
	(♀♀ 82-86	from feathers 17	35	84-102 Baker)

1549 + EL. **Acrocephalus aedon** subspp.

♂♂				
1549 *aedon* (12)	75-82 av. 78.9	13.6-16.3 av. 15.2	23.3-27.2 av. 25.6	78-89 av. 83.1
	(IH 4 ♂♂ 79-87	from skull 18-21	26-29	85-91)
EL. *rufescens* (1)	76	14.7	24.4	81
♀♀				
1549 *aedon* (4)	74, 75, 77, 79	13.8, 14.6 15.3, 17.1	20.6, 22.2, 23.4, 27.3	79, 80, 82, 86
	(IH 9 ♀♀ 78-85	from skull 18-21	26-29	83-89)
EL. *rufescens* (1)	76	14	24	80

1550/52 **Acrocephalus stentoreus** subspp.

	Wing	*Bill*	*Tarsus*	*Tail*
♂♂				
1550 *brunnescens* (17)	76-95 av. 85.3	18-21 av. 19.5	25.4-30 av. 27.5	67-83 av. 76.7
	(IH ♂♂ 84-97	from skull 23-26	28-30	76-85)
1552 *amyae* (3)	76, 81, 84	14.8, 16.0, 20.5	22.8, 24.8, 27.4	65, 71, 85
	(IH 2 ♂♂ 88-91	from skull 25-26	—	79-84)
♀♀				
1550 *brunnescens* (9)	76-90 av. 82.8	17.3-22.5 av. 19.6	23.8-28.2 av. 26	67-78 av. 72.6
	(IH ♀♀ 85-90	from skull 25-26	28-29	72-79)

1553 & EL. **Acrocephalus arundinaceus** subspp.

	Wing	*Bill*	*Tarsus*	*Tail*
♂♂				
1553 *zarudnyi* (5)	92-98 av. 95.4	18-21 av. 19.4	25.8-28 av. 26.5	70-80 av. 76
	(IH 91-102	from skull 20-24	28-32	72-84)
EL. *griseldis* (1)	78	18.5	24.3	62
	(Williamson 80-83	from skull 20-23	24-26	60-68)
♀♀				
1553 *zarudnyi* (1)	90	17.8	25.2	68
	(IH 90-100	20-24	28-32	71-85)
EL. *griseldis* (1)	74	17	26.5	57
	(Williamson 76-83	20-23	24-26	59-66)
o?				
1553 *zarudnyi* (5)	92-99 av. 96.4	18.2-20.6 av. 18.8	24.4-28 av. 26.7	72-79 av. 75.4
EL. *griseldis* (2)	78, 82	17.5, 18.2	24.3, 24.5	60, 63

1554 **Acrocephalus orientalis**

	Wing	*Bill*	*Tarsus*	*Tail*
♂♂ (5)	84-89 av. 85.2	18.6-19.6 av. 19	26.3-28.3 av. 27.4	68-74 av. 71.4
	(IH 75-85	20-24	27-31	67-77)
♀♀ (3)	79, 81, 87	17, 18.7, 19.3	26, 27.5 27.6	66, 68, 73
	(IH 75-83	20-24	27-31	67-71)

1555 **Acrocephalus bistrigiceps bistrigiceps**

	Wing	*Bill*	*Tarsus*	*Tail*
♂ (1)	54	10.4	19.3	46
	(IH 50-58	from skull 12-15	19-33	44-52)
♀ (1)	52	10	17.8	45
	(IH 50-56	from skull 12-15	19-33	42-51)

1545 **Locustella naevia straminea**

	Wing	*Bill*	*Tarsus*	*Tail*
♂♂ (6)	55-58 av. 56.2	9-11 av. 10.3	16,2-19 av. 17.6	49-53 av. 50.8
	(IH ♂♂ 53-62	from skull 13-14	18-19	48-61)
♀♀ (4)	54, 55(2), 56	10.1, 11.4, 12(2)	15.2, 16, 18.2, 18.8	45, 48, 50
	(IH ♀♀ 50-57	from skull 13-14	18-19	48-55)
o? (3)	52, 54, 56	10.7, 11.7, 12.3	16.5, 17.8, 18	47, 48, —

1546 **Schoenicola platyura**

	Wing	*Bill*	*Tarsus*	*Tail*
♂♂ (5)	56-65 av. 63.2	11.1-13 av. 11.7	20-22 av. 20.8	58-69 av. 62
	(IH ♂♂ 64-72	from skull 13-16	21-23	65-73)
o? (1)	64	11	21.8	64
	(IH ♀♀ 63-67	from skull 13-15	21-22	61-66)

1547 **Chaetornis striatus**

	Wing	*Bill*	*Tarsus*	*Tail*
♂♂ (3)	87, 88, 92	10, 12.4, 12.5	28.5, 29, 30.5	88, 89, 90
	(♂♀ 80-92	from feathers *c.* 12	*c.* 28	75-95 Baker)

1548 **Megalurus palustris toklao**

	Wing	*Bill*	*Tarsus*	*Tail*
♂♂ (6)	82-99 av. 91.3	14.8-17.2 av. 15.7	30.6-34.5 av. 31.9	102-123 av. 112.8
	(♂♂ 100-137	from feathers 18-19	39	115-134 Baker)
♂♂ (6) (from Burma)	89-106 av. 97	16.4-17.1 av. 16.6	30.1-36.4 av. 34.5	108-152 av. 122
♀♀ (4)	94-98 av. 95.5	16-16.1 av. 16.03	33.6-35.2 av. 34.4	102-119 av. 111.7
	(♀♀ 82-86	from feathers 17	35	84-102 Baker)

1549 + EL. **Acrocephalus aedon** subspp.

	Wing	*Bill*	*Tarsus*	*Tail*
♂♂				
1549 *aedon* (12)	75-82 av. 78.9	13.6-16.3 av. 15.2	23.3-27.2 av. 25.6	78-89 av. 83.1
	(IH 4 ♂♂ 79-87	from skull 18-21	26-29	85-91)
EL. *rufescens* (1)	76	14.7	24.4	81
♀♀				
1549 *aedon* (4)	74, 75, 77, 79	13.8, 14.6 15.3, 17.1	20.6, 22.2, 23.4, 27.3	79, 80, 82, 86
	(IH 9 ♀♀ 78-85	from skull 18-21	26-29	83-89)
EL. *rufescens* (1)	76	14	24	80

1550/52 **Acrocephalus stentoreus** subspp.

	Wing	*Bill*	*Tarsus*	*Tail*
♂♂				
1550 *brunnescens* (17)	76-95 av. 85.3	18-21 av. 19.5	25.4-30 av. 27.5	67-83 av. 76.7
	(IH ♂♂ 84-97	from skull 23-26	28-30	76-85)
1552 *amyae* (3)	76, 81, 84	14.8, 16.0, 20.5	22.8, 24.8, 27.4	65, 71, 85
	(IH 2 ♂♂ 88-91	from skull 25-26	—	79-84)
♀♀				
1550 *brunnescens* (9)	76-90 av. 82.8	17.3-22.5 av. 19.6	23.8-28.2 av. 26	67-78 av. 72.6
	(IH ♀♀ 85-90	from skull 25-26	28-29	72-79)

1553 & EL. **Acrocephalus arundinaceus** subspp.

	Wing	*Bill*	*Tarsus*	*Tail*
♂♂				
1553 *zarudnyi* (5)	92-98 av. 95.4	18-21 av. 19.4	25.8-28 av. 26.5	70-80 av. 76
	(IH 91-102	from skull 20-24	28-32	72-84)
EL. *griseldis* (1)	78	18.5	24.3	62
	(Williamson 80-83	from skull 20-23	24-26	60-68)
♀♀				
1553 *zarudnyi* (1)	90	17.8	25.2	68
	(IH 90-100	20-24	28-32	71-85)
EL. *griseldis* (1)	74	17	26.5	57
	(Williamson 76-83	20-23	24-26	59-66)
o?				
1553 *zarudnyi* (5)	92-99 av. 96.4	18.2-20.6 av. 18.8	24.4-28 av. 26.7	72-79 av. 75.4
EL. *griseldis* (2)	78, 82	17.5, 18.2	24.3, 24.5	60, 63

1554 **Acrocephalus orientalis**

	Wing	*Bill*	*Tarsus*	*Tail*
♂♂ (5)	84-89 av. 85.2	18.6-19.6 av. 19	26.3-28.3 av. 27.4	68-74 av. 71.4
	(IH 75-85	20-24	27-31	67-77)
♀♀ (3)	79, 81, 87	17, 18.7, 19.3	26, 27.5 27.6	66, 68, 73
	(IH 75-83	20-24	27-31	67-71)

1555 **Acrocephalus bistrigiceps bistrigiceps**

	Wing	*Bill*	*Tarsus*	*Tail*
♂ (1)	54	10.4	19.3	46
	(IH 50-58	from skull 12-15	19-33	44-52)
♀ (1)	52	10	17.8	45
	(IH 50-56	from skull 12-15	19-33	42-51)

1555a & EL. **Acrocephalus scirpaceus** subspp.

	Wing	Bill	Tarsus	Tail
♀				
1555a *fuscus* (1)	65	13	22.3	50
	(IH 59-68	from skull 15-18	22-25	48-55)
♂				
EL. nominate (1)	67	12.7	22.7	52
	(Williamson 59-68	from skull 15-18	22-25	49-56)

1556 **Acrocephalus dumetorum**

♂♂ (34)	58-65 av. 61.4	10.6-15.2 av. 12.9	19.3-23.8 av. 21.7	49-56 av. 52.2
	(IH 60-66	from skull 15-18	21-23	50-55)
♀♀ (37)	57-66 av. 60.2	10.8-15.5 av. 13	19.3-23.2 av. 21.4	47-55 av. 51.4
	(IH 59-66	from skul 15-18	21-23	48-55)
o? (19)	55-65 av. 60.9	10.6-14.5 av. 12.7	19.7-23.3 av. 21.3	48-55 av. 52.5

1557 **Acrocephalus agricola agricola**

♂♂ (12)	51-60 av. 56.1	10.3-12.8 av. 11.3	18.3-24 av. 21.2	45-55 av. 51.3
	(IH 56-61	from skull 14-15	20-23	53-59)
♀♀ (9)	49-57 av. 54.1	10.4-12.6 av. 12	18-21.8 av. 20.1	48-53 av. 52.5
	(IH 56-60	14-15	21-23	53-57)
o? (5)	54-59 av. 56.6	10.9-12.7 av. 11.8	19.1-21.8 av. 20.7	51-59 av. 55

1561a. **Acrocephalus schoenobaenus**

♂ (1)	69	11.4	22.8	48
(British HB	62-71	from skull 13-15	21-22.5	47-55)
♀♀ (2)	62, 65	11.2, 12.4	18.1, 20.7	44, 49
(British HB	62-70	—	—	—)

1562/3 **Hippolais caligata caligata/rama**

♂♂				
1562 nominate (12)	58-64 av. 59.2	9.8-12.3 av. 11.2	17-20.6 av. 18.8	43-51 av. 47.7
	(IH 59-65	from skull 13-15	19-22	47-51)
1563 *rama* (12)	59-62 av. 60.9	10.9-12.2 av. 11.8	18.5-21 av. 20.2	52-56 av. 53.2
	(IH 60-65	from skull 14-16	19-22	50-57)
♀♀				
1562 nominate (15)	56-61 av. 57.6	9.1-12.2 av. 11	17.2-21.1 av. 19	44-50 av. 46.6
	(IH 58-65	from skull 13-15	19-22	46-52)
1563 *rama* (8)	54-60 av. 57.4	11.2-13.6 av. 12.2	17-21.9 av. 19.4	52-59 av. 54
	(IH 58-62	from skull 15-16	20-21	49-57)

	Wing	Bill	Tarsus	Tail
o?				
1562 nominate (7)	54-61 av. 58	9.8-12.2 av. 10.8	17.2-20.9 av. 18.6	47-50 av. 48.5
1563 *rama* (5)	60-61 av. 60.2	10.5-12 av. 11	17.2-23.8 av. 19.5	53-55 av. 53.7

1564 **Hippolais languida**

♀ (1)	76	15.2	21.8	56
	(IH 72-75	from skull 18-21	21-22	60-72)

EL. **Hippolais pallida elaeica**

♂♂ (7)	62-70 av. 65.7	11.8-13.4 av. 12.6	17.7-20.6 av. 19.7	49-55 av. 51.8
	(British HB. 64-68	from skull 12.5-14	20-23	50-55)
♀♀ (2)	66, 60	12.8, 12.3	21, 20.2	51, 50
	(British HB. 63-65	12.5-14	20-23	50-55)
o? (3)	62, 66, 68	11.9, 12.7, 11.6	21.6, 17.8, 21.4	47, 52, 52

1564a. **Sylvia nisoria**

♂♂ (2)	87, 88	12.1, 12.7	23.3, 24	69, 71
	(IH 83-90	from skull 16-18	24-26	64-79 ex Williamson)
o? (3)	86, 86, 87	12.8, 14.4 —	20.4, 22.4, 23.8	68, 69, 71

1565 & EL. **Sylvia hortensis** subspp.

♂♂				
1565 *jerdoni* (5)	77-79 av. 78.2	13.3-16 av. 15.3	19.4-23.6 av. 21.8	63-70 av. 66.4
	(IH 79-86	from skull 19-21	23-25	66-72)
EL. *hortensis* (1)	77	13.3	20.4	64
	(Williamson 72-83	from skull 15-18	22.5-25	60-71)
♀♀				
1565 *jerdoni* (10)	76-80 av. 77.7	14.3-17.5 av. 15.7	19.4-22 av. 20.8	63-70 av. 66.9
	(IH 77-83	from skull 19-21	23-25	67-71 H.W., S.A.)
o?				
1565 *jerdoni* (4)	77, 78, 78, 79	14.7, 14.8, 17, 17.2	20.4, 21.3, 21.4, 21.7	66, 66, 67, —

1566 **Sylvia communis icterops**

♂♂ (6)	71-75 av. 72.3	10.6-11.8 av. 11.3	19.5-21.9 av. 21	61-64 av. 62.6
	(IH 73-77	from skull 11-13	20-22	60-65)
♀♀ (9)	69-74 av. 71.5	9.3-11.8 av. 10.5	19.4-21.2 av. 19.8	56-64 av. 61.5
	(IH 73-76	from skull 11-13	21-22	58-66)
o? (2)	72, 73	10, 10.5	21.1, 21.6	60, 62

1555a & EL. **Acrocephalus scirpaceus** subspp.

	Wing	*Bill*	*Tarsus*	*Tail*
♀				
1555a *fuscus* (1)	65	13	22.3	50
	(HB 59-68	from skull 15-18	22-25	48-55)
♂				
EL. nominate (1)	67	12.7	22.7	52
	(Williamson 59-68	from skull 15-18	22-25	49-56)

1556 **Acrocephalus dumetorum**

	Wing	*Bill*	*Tarsus*	*Tail*
♂♂ (34)	58-65 av. 61.4	10.6-15.2 av. 12.9	19.3-23.8 av. 21.7	49-56 av. 52.2
	(HB 60-66	from skull 15-18	21-23	50-55)
♀♀ (37)	57-66 av. 60.2	10.8-15.5 av. 13	19.3-23.2 av. 21.4	47-55 av. 51.4
	(HB 59-66	from skul 15-18	21-23	48-55)
o? (19)	55-65 av. 60.9	10.6-14.5 av. 12.7	19.7-23.3 av. 21.3	48-55 av. 52.5

1557 **Acrocephalus agricola agricola**

	Wing	*Bill*	*Tarsus*	*Tail*
♂♂ (12)	51-60 av. 56.1	10.3-12.8 av. 11.3	18.3-24 av. 21.2	45-55 av. 51.3
	(HB 56-61	from skull 14-15	20-23	53-59)
♀♀ (9)	49-57 av. 54.1	10.4-12.6 av. 12	18-21.8 av. 20.1	48-53 av. 52.5
	(HB 56-60	14-15	21-23	53-57)
o? (5)	54-59 av. 56.6	10.9-12.7 av. 11.8	19.1-21.8 av. 20.7	51-59 av. 55

1561a. **Acrocephalus schoenobaenus**

	Wing	*Bill*	*Tarsus*	*Tail*
♂ (1)	69	11.4	22.8	48
(British HB	62-71	from skull 13-15	21-22.5	47-55)
♀♀ (2)	62, 65	11.2, 12.4	18.1, 20.7	44, 49
(British HB	62-70	—	—	—)

1562/3 **Hippolais caligata caligata/rama**

	Wing	*Bill*	*Tarsus*	*Tail*
♂♂				
1562 nominate (12)	58-64 av. 59.2	9.8-12.3 av. 11.2	17-20.6 av. 18.8	43-51 av. 47.7
	(HB 59-65	from skull 13-15	19-22	47-51)
1563 *rama* (12)	59-62 av. 60.9	10.9-12.2 av. 11.8	18.5-21 av. 20.2	52-56 av. 53.2
	(HB 60-65	from skull 14-16	19-22	50-57)
♀♀				
1562 nominate (15)	56-61 av. 57.6	9.1-12.2 av. 11	17.2-21.1 av. 19	44-50 av. 46.6
	(HB 58-65	from skull 13-15	19-22	46-52)
1563 *rama* (8)	54-60 av. 57.4	11.2-13.6 av. 12.2	17-21.9 av. 19.4	52-59 av. 54
	(HB 58-62	from skull 15-16	20-21	49-57)

	Wing	*Bill*	*Tarsus*	*Tail*
o?				
1562 nominate (7)	54-61 av. 58	9.8-12.2 av. 10.8	17.2-20.9 av. 18.6	47-50 av. 48.5
1563 *rama* (5)	60-61 av. 60.2	10.5-12 av. 11	17.2-23.8 av. 19.5	53-55 av. 53.7

1564 **Hippolais languida**

	Wing	*Bill*	*Tarsus*	*Tail*
♀ (1)	76	15.2	21.8	56
	(HB 72-75	from skull 18-21	21-22	60-72)

EL. **Hippolais pallida elaeica**

	Wing	*Bill*	*Tarsus*	*Tail*
♂♂ (7)	62-70 av. 65.7	11.8-13.4 av. 12.6	17.7-20.6 av. 19.7	49-55 av. 51.8
	(British HB. 64-68	from skull 12.5-14	20-23	50-55)
♀♀ (2)	66, 60	12.8, 12.3	21, 20.2	51, 50
	(British HB. 63-65	12.5-14	20-23	50-55)
o? (3)	62, 66, 68	11.9, 12.7, 11.6	21.6, 17.8, 21.4	47, 52, 52

1564a. **Sylvia nisoria**

	Wing	*Bill*	*Tarsus*	*Tail*
♂♂ (2)	87, 88	12.1, 12.7	23.3, 24	69, 71
	(HB 83-90	from skull 16-18	24-26	64-79 ex Williamson)
o? (3)	86, 86, 87	12.8, 14.4 —	20.4, 22.4, 23.8	68, 69, 71

1565 & EL. **Sylvia hortensis** subspp.

	Wing	*Bill*	*Tarsus*	*Tail*
♂♂				
1565 *jerdoni* (5)	77-79 av. 78.2	13.3-16 av. 15.3	19.4-23.6 av. 21.8	63-70 av. 66.4
	(HB 79-86	from skull 19-21	23-25	66-72)
EL. *hortensis* (1)	77	13.3	20.4	64
	(Williamson 72-83	from skull 15-18	22.5-25	60-71)
♀♀				
1565 *jerdoni* (10)	76-80 av. 77.7	14.3-17.5 av. 15.7	19.4-22 av. 20.8	63-70 av. 66.9
	(HB 77-83	from skull 19-21	23-25	67-71 H.W., S.A.)
o?				
1565 *jerdoni* (4)	77, 78, 78, 79	14.7, 14.8, 17, 17.2	20.4, 21.3, 21.4, 21.7	66, 66, 67, —

1566 **Sylvia communis icterops**

	Wing	*Bill*	*Tarsus*	*Tail*
♂♂ (6)	71-75 av. 72.3	10.6-11.8 av. 11.3	19.5-21.9 av. 21	61-64 av. 62.6
	(HB 73-77	from skull 11-13	20-22	60-65)
♀♀ (9)	69-74 av. 71.5	9.3-11.8 av. 10.5	19.4-21.2 av. 19.8	56-64 av. 61.5
	(HB 73-76	from skull 11-13	21-22	58-66)
o? (2)	72, 73	10, 10.5	21.1, 21.6	60, 62

1567/1570 & EL. **Sylvia curruca** subspp.

	Wing	*Bill*	*Tarsus*	*Tail*
♂♂				
1567 *blythi* (29)	59-68 av. 63.5	9-11.7 av. 10.1	17-20.5 av. 18.5	52-60 av. 55.5
	(IH 61-68	from skull 12-13	18-23	54-62)
1568 *halimodendri* (1)	63	9.9	18.6	54
	(IH 57-64	from skull 11-13	18-20	55-60)
1569 *minula* (6)	58-64 av. 61.1	8.8-10.4 av. 9.4	16.7-20.8 av. 18.7	49-57 av. 52.5
	(IH 58-65	from skull 11-12	20-23	50-58)
1570 *althaea* (7)	58-70 av. 65.5	9.8-12.2 av. 10.8	15.5-21.8 av. 19.6	54-57 av. 55.5
	(IH 63-71	from skull 14-15	19-22	52-61)
EL. nominate (4)	65, 66 (2), 67	8.7, 8.8, 9.5, 10.1	17, 18.3, 19.5, 19.9	55, 56, 58, 59
	63-70	from skull 10.5-12	20-21	52-56)
♀♀				
1567 *blythi* (22)	58-66 av. 61.8	9.1-11 av. 9.9	17.1-21.5 av. 18.7	50-56 av. 53.7
	(IH 61-67	—	19-21	53-61)
1569 *minula* (6)	58-62 av. 60	8.3-10.4 av. 9.1	16.7-21 av. 18	52-58 av. 53.3
	(IH 58-65	from skull 11-12	20-23	50-58)
1570 *althaea* (2)	65, 68	11.4, 12	18.3, 20.5	47, 52
	(IH 63-71	from skull 14-15	19-22	52-61)
o?				
1567 *blythi* (13)	58-69 av. 63.9	9.5-12.2 av. 10.2	18-21.8 av. 19.4	51-63 av. 56.2
1569 *minula* (4)	58-64 av. 60	8.9-9.5 av. 9.3	18-20 av. 18.6	48-58 av. 52.5
1570 *althaea* (6)	64-71 av. 67.3	9.5-11.8 av. 10.2	18.5-20.5 av. 19	52-57 av. 55.8
EL. nominate (2)	63, 66	9.5, 9.9	16.5, 19	51, 54

1571 **Sylvia nana nana**

	Wing	*Bill*	*Tarsus*	*Tail*
♂♂ (4)	55, 58, 58, 59	7.9, 8.8, 9.5, 9.9	17.5, 17.7, 18.1, 19.2	46, 47, 48, 51
	(IH 57-60	from skull 11-12	*c.* 18	46-51)
♀♀ (5)	55-59 av. 56.8	7.7-9.8 av. 8.6	17.3-19.9 av. 18.5	44-47 av. 46.2
	(IH 54-58	from skull 11-12	*c.* 18	*c.* 47)

1571a. **Sylvia mystacea**

	Wing	*Bill*	*Tarsus*	*Tail*
♂♂ (6)	58-63 av. 59.5	10.1-11 av. 10.5	17-18.6 av. 17.9	53-56 av. 55.6
(Birds of Soviet Union	57-62 av. 59.9	11-12 av. 11.6	18-19 av. 18.4	55-60 av. 58.3)
♀♀ (7)	57-66 av. 60.4	9.2-10.2 av. 9.6	17.1-18.5 av. 17.8	50-57 av. 54
(Birds of Soviet Union	56	12	18	55)
o? (4)	57, 60, 62, 66	9.4, 9.6, 10.3, 10.9	15.8, 17.5, 18.6, —	51, 56, 58, 59

EL. Sylvia atricapilla

	Wing	*Bill*	*Tarsus*	*Tail*
♂♂ (3)	76, 76, 78	11.7, 11.7, 11.7	18, 20.3, 21.2	62, —, —
(Birds of Soviet Union	73-87.6 av. 76.7	12-15		60-65)
♀ (1)	76	12.2	20.7	59
	63-77 av. 69.5	12-15		60-65)

EL. Sylvia borin

♂♂ (2)	72	11.6	21.2	56
(Williamson ♂♀	73-84	from skull 12.5-15	20-22	50-61)
♀♀ (2)	77, 77	11.2, 11.3	18.8, 20.2	53, 56

(to be continued)

1567/1570 & EL. **Sylvia curruca** subspp.

	Wing	*Bill*	*Tarsus*	*Tail*
♂♂				
1567 *blythi* (29)	59-68 av. 63.5	9-11.7 av. 10.1	17-20.5 av. 18.5	52-60 av. 55.5
	(IH 61-68	from skull 12-13	18-23	54-62)
1568 *halimodendri* (1)	63	9.9	18.6	54
	(IH 57-64	from skull 11-13	18-20	55-60)
1569 *minula* (6)	58-64 av. 61.1	8.8-10.4 av. 9.4	16.7-20.8 av. 18.7	49-57 av. 52.5
	(IH 58-65	from skull 11-12	20-23	50-58)
1570 *althaea* (7)	58-70 av. 65.5	9.8-12.2 av. 10.8	15.5-21.8 av. 19.6	54-57 av. 55.5
	(IH 63-71	from skull 14-15	19-22	52-61)
EL. nominate (4)	65, 66 (2), 67	8.7, 8.8, 9.5, 10.1	17, 18.3, 19.5, 19.9	55, 56, 58, 59
	63-70	from skull 10.5-12	20-21	52-56)
♀♀				
1567 *blythi* (22)	58-66 av. 61.8	9.1-11 av. 9.9	17.1-21.5 av. 18.7	50-56 av. 53.7
	(IH 61-67	—	19-21	53-61)
1569 *minula* (6)	58-62 av. 60	8.3-10.4 av. 9.1	16.7-21 av. 18	52-58 av. 53.3
	(IH 58-65	from skull 11-12	20-23	50-58)
1570 *althaea* (2)	65, 68	11.4, 12	18.3, 20.5	47, 52
	(IH 63-71	from skull 14-15	19-22	52-61)
o?				
1567 *blythi* (13)	58-69 av. 63.9	9.5-12.2 av. 10.2	18-21.8 av. 19.4	51-63 av. 56.2
1569 *minula* (4)	58-64 av. 60	8.9-9.5 av. 9.3	18-20 av. 18.6	48-58 av. 52.5
1570 *althaea* (6)	64-71 av. 67.3	9.5-11.8 av. 10.2	18.5-20.5 av. 19	52-57 av. 55.8
EL. nominate (2)	63, 66	9.5, 9.9	16.5, 19	51, 54

1571 **Sylvia nana nana**

♂♂ (4)	55, 58, 58, 59	7.9, 8.8, 9.5, 9.9	17.5, 17.7, 18.1, 19.2	46, 47, 48, 51
	(IH 57-60	from skull 11-12	*c.* 18	46-51)
♀♀ (5)	55-59 av. 56.8	7.7-9.8 av. 8.6	17.3-19.9 av. 18.5	44-47 av. 46.2
	(IH 54-58	from skull 11-12	*c.* 18	*c.* 47)

1571a. **Sylvia mystacea**

♂♂ (6)	58-63 av. 59.5	10.1-11 av. 10.5	17-18.6 av. 17.9	53-56 av. 55.6
(Birds of Soviet Union	57-62 av. 59.9	11-12 av. 11.6	18-19 av. 18.4	55-60 av. 58.3)
♀♀ (7)	57-66 av. 60.4	9.2-10.2 av. 9.6	17.1-18.5 av. 17.8	50-57 av. 54
(Birds of Soviet Union	56	12	18	55)
o? (4)	57, 60, 62, 66	9.4, 9.6, 10.3, 10.9	15.8, 17.5, 18.6, —	51, 56, 58, 59

EL. **Sylvia atricapilla**

	Wing	*Bill*	*Tarsus*	*Tail*
♂♂ (3)	76, 76, 78	11.7, 11.7, 11.7	18, 20.3, 21.2	62, —, —
(Birds of Soviet Union	73-87.6 av. 76.7	12-15		60-65)
♀ (1)	76	12.2	20.7	59
	63-77 av. 69.5	12-15		60-65)

EL. **Sylvia borin**

♂♂ (2)	72	11.6	21.2	56
(Williamson ♂♀	73-84	from skull 12.5-15	20-22	50-61)
♀♀ (2)	77, 77	11.2, 11.3	18.8, 20.2	53, 56

(*to be continued*)

NEW DESCRIPTIONS

A NEW SPECIES OF *GAGEA* (LILIACEAE) FROM PAKISTAN[1]

Syamali Dasgupta & D. B. Deb[2]

(*With a text-figure*)

A new species of *Gagea* Salisb. (Liliaceae) is described from Pakistan.

Gagea toppinii sp. nov.

Differt a *G. lutea* (L.) Ker-Gawl. foliis caulinis linearibus, foliis radicalibus bulbiferisque ubi affixis in plantis maturis, perianthiisque exteriore villosis; ab *G. anisanthos* C. Koch statura multo minore, perianthiis exteriore villosis, ovariis supra non depressis. Typus: Pakistan, Chitral, *Major S. N. Toppin* 17 (holotypus K).

Herba bulbifera, gregaria, parva, erecta; bulbi ovoidei, basi folii carnosi solitarii formantes, basibus 2-3 foliorum, radicalium siccis annorum praecedentium circumcincti; bulbeli 1 vel 2, saepe folia ferentes ubi affixi ad plantem maternum. Folia radicalia saepe duo, linearia, glabra, inflorescentiam superantia, caulis teres, pubescens, folia duas inaequilongas ferens in inflorescentiis terminalibus. Folia caulina subopposita, linearia inaequalia, superiora perbreviora. Inflorescentia 3-4 florifera, scorpioidei cymosa, condensis. Flores bisexuales, hypogyni, campanulati; bracteae foliaceae, lineares. Perianthia biseriata, segmenta 6, libera, costa prominens; segmenta exteriora dorsali pubescentia. Stamina 6, libera; fila perianthii basi adherentia; antherae oblongae basifixae, dehiscentes latrorse. Pistilla syncarpa; ovarium sessile, oblongum, triloculare, triquetrum; stylus triquetrus; stigmata trifida, truncata. Fructus non visus.

Herbs small, erect, gregarious, 6-8 cm long, bulbous; bulbs 4-5 mm x 3-4 mm, ovoid, formed of a solitary fleshy radical leaf base, surrounded by 2-3 dry previous years' radical leaf bases; bulbel 1 or 2, bearing leaf when still attached to the mother plant. Radical leaves 10-11 cm long, ± 1 mm broad,

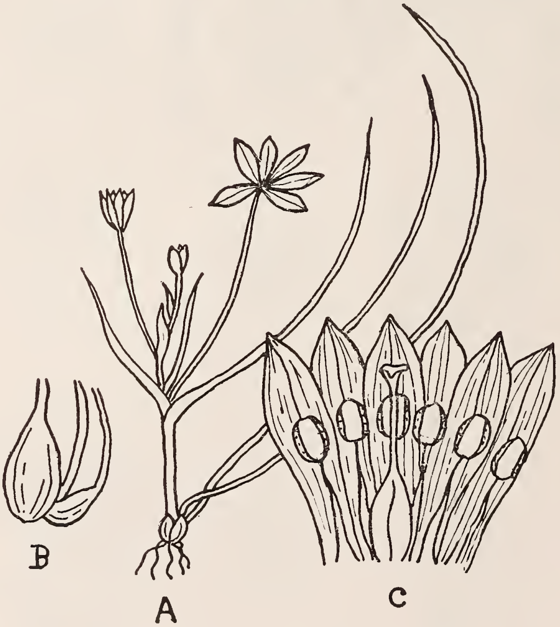

Fig. 1. *Gagea toppinii* sp. nov.
A. Habit; B. Bulb without outer scales and with bulbel; C. Floral parts.

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[1] Accepted July 1985.

[2] Botanical Survey of India, Howrah.

linear, acute at the apex, fleshy at the base, glabrous, overtopping the inflorescence. Stem 1.5-2 cm long, terete, pubescent, bearing 2 unequal leaves below the terminal inflorescence. Cauline leaves subopposite, unequal, 1.5-6 cm long, linear, ± 1 mm broad at the base, the lower overtopping the inflorescence, the upper much shorter. Inflorescence 3-4 flowered, condensed scorpoid cyme. Flowers bisexual, hypogynous, broadly campanulate; pedicel 3-6 cm long, slender, pubescent; bracts foliaceous, 3-5 mm long, linear. Perianth biseriate, segments 6, free, 7-8 mm long, 1.7-2 mm broad, oblanceolate, acute at the apex, midvein prominent, dorsal side of outer segments pubescent. Stamens 6, free; filaments ± 4 mm long, 0.5 mm broad at the base, linear, attached at the base of the perianth; anthers ± 1.2 mm long, ± 1 mm broad, oblong, basifixed, latrorse in dehiscence. Pistil syncarpous, tricarpellary; ovary sessile, 3-3.5 mm long, ± 1 mm broad, oblong, trilocular, triquetrous; style 3-3.5 mm long, ± 0.5 mm across, stout, linear, triquetrous; stigma trifid, truncate. Fruit not seen. (Fig. 1).

PAKISTAN: Chitral, Drosh, 4500 ft, March 1908, *Major S. M. Toppin* 17 (holotype K).

We are grateful to the Director and Keeper of the Royal Botanic Gardens, Kew for the loan of specimens for revision of the genus *Gagea* in India and adjoining regions, which resulted in the discovery of this species.

DESCRIPTION OF A NEW GALL MIDGE SPECIES (DIPTERA: CECIDOMYIIDAE) FROM MAHARASHTRA, INDIA[1]

R. M. SHARMA[2]

(*With fourteen text-figures*)

A new species of *Odontodiplosis* Felt, *O. raoi* sp. nov. is fully described and illustrated. A key to Indian species is also provided for easy identification.

Odontodiplosis raoi sp. nov.

MALE: Body 1.10 mm long. Eyes confluent above. Trophi slightly produced. *Palpus*: quadriarticulate, moderately long, light-straw, sparsely setose; first segment (10:5) short, length 2.00 x its maximum thickness; second segment (14:6) cylindrical, longer than first, length 2.33 x its maximum thickness; third segment (14:6) cylindrical, broad subapically, as long as second; fourth segment (19:5) cylindrical, longest of all, 3.80 x its maximum thickness. *Antenna*: Longer than body with 2 + 12 binodose, tricircumfilar segments, basal enlargement with one and apical with two whorls of regular circumfila; scape (10:17) cupshaped, pedicel (13:13) globose; third segment (50) confluent with and as long as fourth, with a very small basal prolongation (3:4), basal enlargement globose, 0.24 the length of the segment and as long as broad, basal stem (10:5) 0.83 the length of the basal enlargement and twice as long as thick; apical enlargement (15:11) longer than basal, 1.36 x its maximum thickness, apical stem (12:5) 0.80 the length of the apical enlargement and 2.40 x as long as thick; fourth segment (50) similar to the third, except for the apical stem (12:4) measuring 3.00 x its maximum thickness; fifth segment (48) shorter

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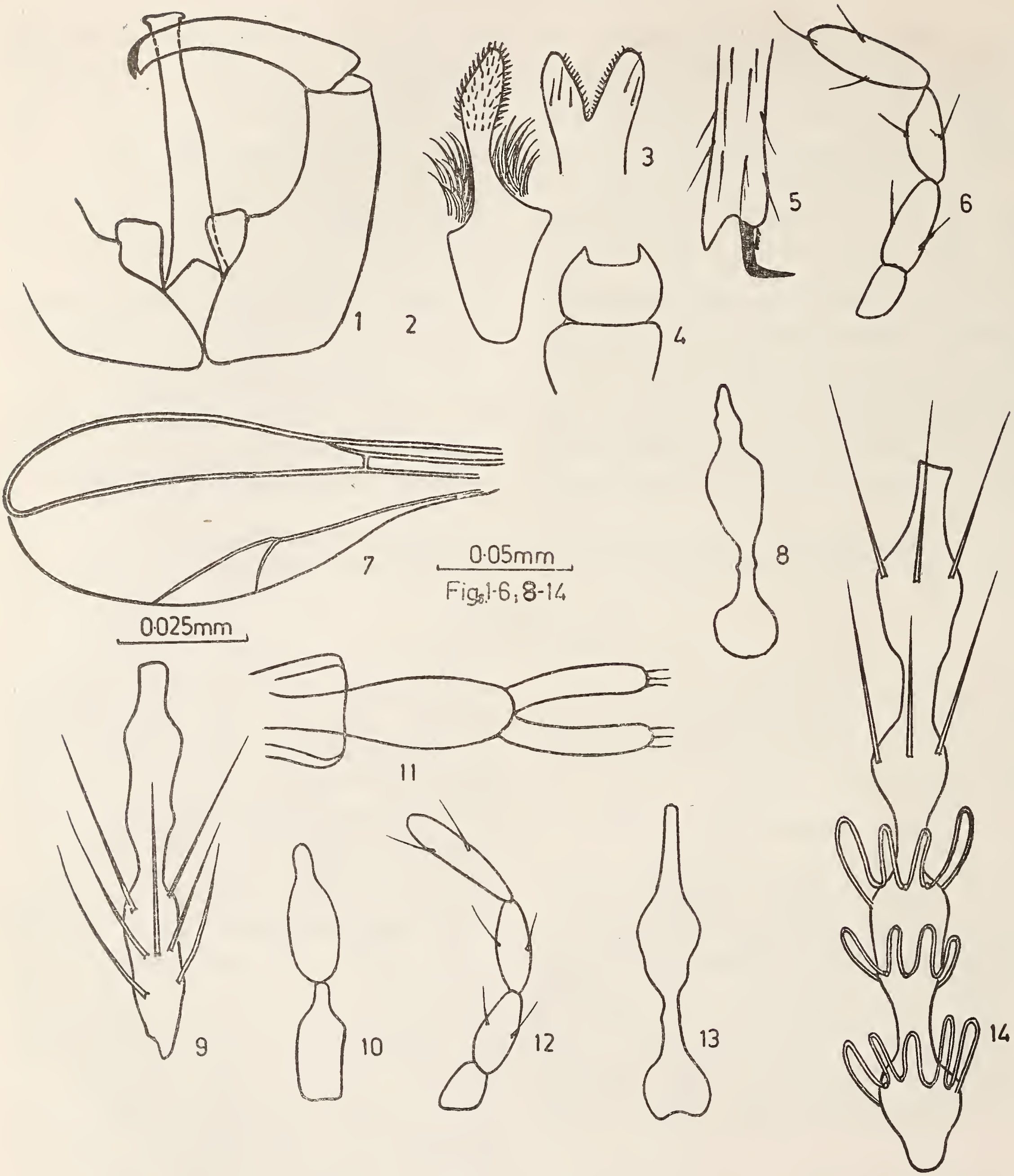
[1] Accepted April 1985.

[2] Zoological Survey of India, Western Regional Station, Pune-411 016, India.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Figs. 1-14. *Odontodiplosis raoi* sp. nov.
1. Genitalia ♂; 2. Subdorsal plate; 3. Dorsal plate; 4. Scape & pedicel ♂; 5. Claw ♂; 6. Palpus ♂; 7. Wing ♂; 8. Terminal antennal segments ♂; 9. Third & fourth antennal segments ♀; 12. Palpus ♀; 13. Penultimate antennal segment ♂; 14. Third & fourth antennal segments ♂.

than fourth, basal enlargement (10:12) subglobose, 0.25 the length of the segment and wider than long, basal stem (10:4) as long as basal enlargement, 2.50 x as long as thick; apical enlargement (15:12) 1.50 x longer than basal enlargement and 1.25 x as long as thick; apical stem (15:4) as long as apical enlargement, 3.75 x its maximum thickness, distal segments gradually becoming shorter and thinner; terminal segment (40), shortest of all, basal enlargement (8:9) 0.20 the length of the segment and slightly wider than long, basal stem (10:2) longer than basal enlargement and 5.00 x as long as thick; apical enlargement (12:8) 1.50 x longer than basal enlargement and 1.50 x as long as thick, apical stem (9:4) in the form of an apical knob, 0.75 the length of the apical enlargement and 2.25 x as long as thick. *Wing*: (53:19) hyaline, 2.78 x as long as broad, costa hairy, vein *R1* ending a little beyond the basal ¼ of the wing, vein *Rs* distinct, Vein *R5* evenly curved, reaching wing margin well beyond the apex and interrupting costa at its union, vein *Cu* forked. *Legs*: long, densely hairy, metatarsus (8) shorter than terminal tarsal segment, second segment (45) longest of all, shorter than the following segments combined together (46); claw simple on all legs, bent at right angles; empodium rather narrow and rudimentary. *Genitalia*: Yellowish-brown, basal clasp segment (40:15) cylindrical, broad basally, with a very small triangular basal lobe, length 2.66 x its maximum thickness; terminal clasp segment (31: 5) slender, gradually tapering towards the tip, ending in a tooth, 0.77 the length of the basal clasp segment and 6.20 x as long as thick; dorsal plate deeply bilobed (20:20), lobes triangular, setose, shorter than subdorsal plate; subdorsal plate (42:15) entire, straight, broad basally and subapically, narrowed medially, pubescent, tip pointed or rounded; a pair of quadrate paramere lobes surrounding basal portion of aedeagus; cock's comb-like curved setae present at the basal portion of subdorsal plate on either side; aedeagus (50:5) cylindrical, longer than basal clasp segment and sub dorsal plate, tip truncate with a median notch, length 10.00 x its maximum thickness.

FEMALE: Body 1.10 mm long, including ovipositor. Eyes, trophi and palpus as in male. *Antenna*: shorter than body, with 2 + 12 cylindrical segments with moderately long apical stems, enlargements with three whorls of long setae and low circumfila; scape and pedicel as in male; third segment (31) confluent with and longer than fourth, with a small basal prolongation (2:3) enlargement (21:8) 0.67 the length of the segment and 2.62 x as long as thick, stem (8:4) 0.38 the length of the enlargement and 2.00 x its maximum thickness; fourth segment (25) with enlargement (18:8) 0.61 the length of the segment and 2.25 x as long as thick, stem (7:3) 0.38 the length of the enlargement and 2.33 x as long as thick; fifth segment (22) shorter than fourth; penultimate segment (17) longer than twelfth; terminal segment (20) longer than penultimate, enlargement (14:7) 0.70 the length of the segment and twice as long as thick, stem in the form of a nipple-like prolongation (6:3), 0.42 the length of the enlargement and 2.00 x as long as thick. Wing, legs and claw as in male. *Ovipositor*: exerted, lamellate, lamellae (20:5) sparsely setose, cylindrical, length 4.00 x as long as thick.

Holotype: ♂, mounted on slide, INDIA, Maharashtra, Aurangabad, at light, 16.vii.1976, coll. R. M. Sharma.

Allotype: ♀, mounted on slide, *Paratypes*:

7 ♂♂ mounted on slides, data same as holotype.

All the types are deposited in the collections of Zoological Survey of India, Pune for the time being.

The species is named in honour of my teacher Prof. S. N. Rao (Retd), Marathwada University, Aurangabad, who has contributed much to the knowledge of Indian gall-midges.

KEY TO INDIAN SPECIES OF *Odontodiplosis* FELT

1. Palpi triarticulate .... *muirshikha* Grover & Bakshi, 1977-78
   Palpi quadriarticulate 2
2. Wings spotted .... *punctipennis* Grover & Bakshi, 1977-78
   Wings not spotted 3
3. Basal clasp segment with a large obtuse basal lobe, parameres wanting, dorsal plate bilobed, denticulate; subdorsal plate triangular; cock's comb-like projections present between subdorsal plate and aedeagus on either side .... *orientalis* Sharma & Rao, 1979
   Basal clasp segment with a small triangular basal lobe, parameres present, dorsal plate bilobed, simple, subdorsal plate entire, straight, cock's comb-like curved setae present at the middle portion of subdorsal plate on either side .... *raoi* sp. nov.

ACKNOWLEDGEMENTS

I am thankful to Dr. B. K. Tikader, Director, Zoological Survey of India, Calcutta and the Officer-in-Charge, Zoological Survey of India, Pune for facilities.

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SHARMA, R. M. & RAO, S. N. (1979): *Odontodiplosis orientalis*, a new Indian gall-midge (Diptera: Cecidomyiidae). *Oriental Ins., 13*(3-4): 299-302.

A NEW SUBSPECIES OF *SIMOCEPHALUS VIDYAE* RANE, 1983 (CLADOCERA, DAPHNIDAE) FROM JABALPUR, MADHYA PRADESH, INDIA[1]

PRAMOD D. RANE[2]

(*With six text-figures*)

INTRODUCTION

During the study of cladocera from Madhya Pradesh, Rane (1983) described a new species *Simocephalus vidyae* from Jabalpur district. While working on other accumulated collection I came across nine specimens of the same species, which though they have main diagnostic character, i.e. very large rostrum and long beak like front of the head also have several other characters by which they can be distinguished from *S. vidyae.* Therefore these specimens are described here as a new subspecies.

DISCRIPTION

Simocephalus vidyae gajareae subsp. nov.
(Figs. 1-6)

Material — 1 ♀ (holotype) and 8 ♀♀ (paratypes), Balsager tank behind medical college, *c* 7 km. s/w on Shahpura Road, 18 July 1982, Jabalpur, Madhya Pradesh, India,

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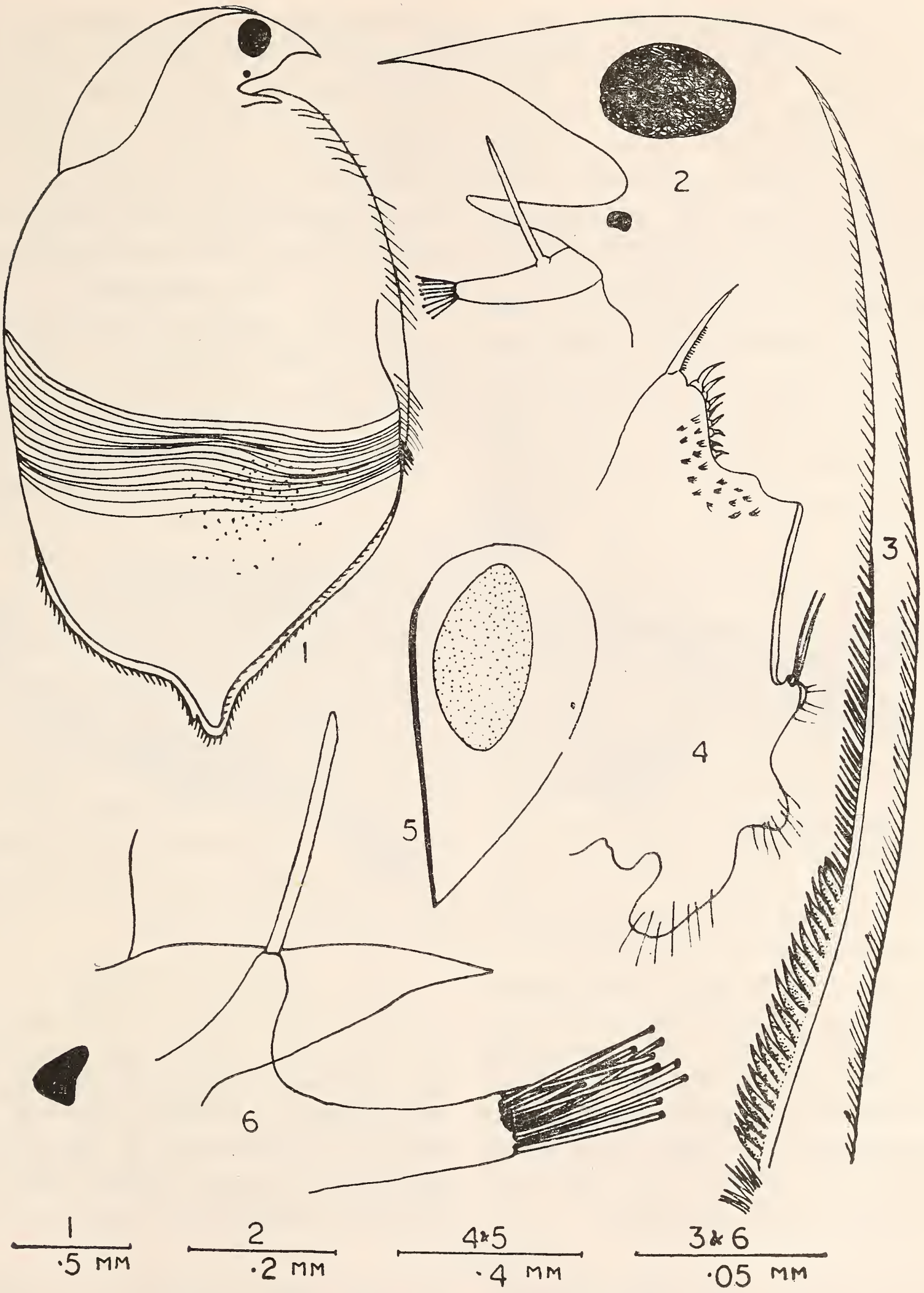
[1] Accepted June 1985.

[2] Zoological Survey of India, Central Regional Station, 1544, A Napier Town, Jabalpur, M.P., India.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Figs. 1-6. *Simocephalus vidyae gajareae* subsp. nov.
1. parthenogenetic female; 2. pointed head portion and long rostrum; 3. Claw with proximal and distal pecten; 4. postabdomen; 5. epiphial egg and 6. antennule.

coll. P. D. Rane. The types are deposited in National collection of Zoological Survey of India, Calcutta, West Bengal. (holotype, C 3482/2; paratypes, C 3483/2 and C 3484/2).

Carapace seen laterally, broadly rectangular, with large bilobed protuberance in the middle; dorsal margin almost straight and curved posterior part situated at some distance above the protuberance; hind edge of the valve straight, oblique and joining the inferior edge at an obtuse angle. One-third posterior part of the dorsal margin strongly denticulate, the denticles being continued on terminal lobed protuberance and hind edges of valve. The denticles on hinder edge are smaller than that of posterior dorsal margin. The denticles on caudal part and hind part situated very close to each other but those on the dorsal side separated by some distance. Head very prominent having fornix greatly expanded. Front of head pointed like a beak. Vertex angulate, rostral projection very large. Eye large without refractive bodies. Ocellus small, rhomboidal or sometimes triangular. Tail piece broad, with supra-anal angle slightly produced. Anal denticles about 8 on each side. Apical claws, slender and nearly straight, with proximal pecten with small 6 to 7 teeth, distal pecten with large 15 to 21 teeth and with row of fine setae distally to the distal pecten at outer margin. Inner margin of claw also with fine long setae extend from base to tip of claw. Teeth of proximal pecten straight while that of distal pecten slightly bend towards the tip of claw. Antennules of female slightly curved with large sensory hair at upper margin, arising from knob like expansion and about nine sensory setae present at the tip. Colour blackish-green. Length of holotype female 3.3 mm, Width 2.1 mm, with about 32 developing embryos inside brood pouch. Ephippial female is smaller than parthenogenetic female. Length, 2.2 mm, with blunt protuberance and one large ephippial egg. Colour of the ephippium is light yellow which is slightly darker along circular borders. Male unknown.

RELATIONSHIPS

The new subspecies *Simocephalus vidyae gajareae* closely resembles *S. vidyae* Rane in having large rostrum and pointed beak like front of the head but can be separated on the basis of following characters: 1) Length of *S. vidyae* is 2.56 mm; while length of *S. v. gajareae* is 3.33 mm; 2) Carapace of *S. vidyae* in lateral view broadly oval and dorsal margin evenly curved while that of *S. v. gajareae* is rectangular and dorsal margin is almost straight; 3) The posterior protuberance in *S. vidyae* is small and pointed while in *S. v. gajareae* it is very large and bilobed; 4) *S. vidyae* has 13-15 straight teeth present at distal pecten while in *S. v. gajareae* there are 15-21 teeth which are slightly bent towards claw and 5) The number of developing embryos in *S. vidyae* is about 15-20 while in *S. v. gajareae* the number may reach up to 34.

ACKNOWLEDGEMENTS

I am thankful to Dr. P. D. Gupta, Deputy Director, and Officer-in-Charge, Zoological Survey of India, Jabalpur for his keen interest, encouragement, facilities and for going through the manuscript. I also grateful to Shri Satish Fadnavis for his kind help in drawing the figures.

REFERENCE

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A NEW FRESHWATER FISH OF THE GENUS *BARILIUS* HAMILTON (PISCES: CYPRINIDAE) FROM WEST BENGAL, INDIA[1]

R. P. Barman[2]

(*With a text-figure*)

A new species of the cyprinid fish genus *Barilius* Hamilton collected from Jalpaiguri district (North Bengal), West Bengal, India is described under the name *B. howesi.* The new species is related to *B. barna* (Hamilton) and *B. barila* (Hamilton) but clearly differs from them in head length, body depth and eye diameter.

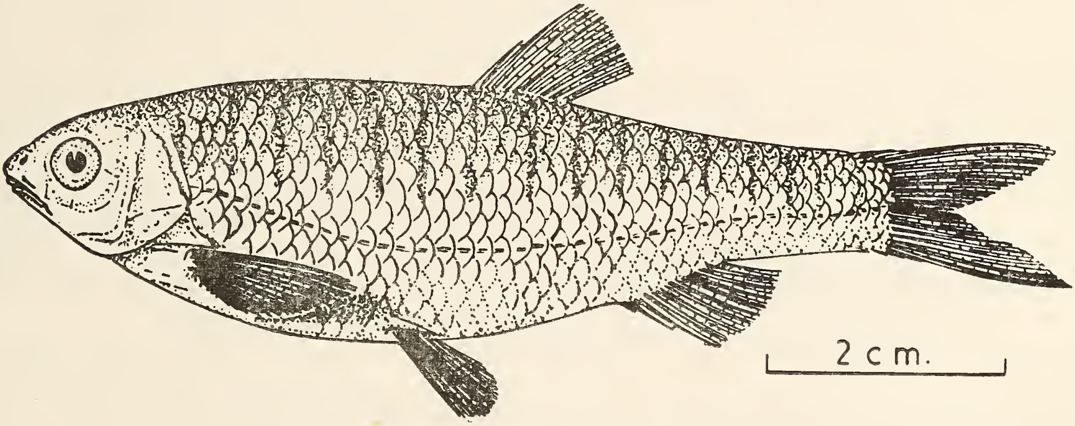

Fig. 1. Lateral view of the holotype of *Barilius howesi* sp. nov.

INTRODUCTION

Day (1889) recorded 14 species and Jayaram (1981) enumerated 16 belonging to the genus *Barilius* from the Indian subcontinent. Barman (1985) has since added one more new species under the genus from Arunachal Pradesh (formerly NEFA) India which lies between 27°-27.5°N latitude and 96.5°-97° E longitude. During the course of my revisionary studies on the cyprinid fish genus *Barilius* Hamilton from the Indian subcontinent, I came across three examples which, when compared with the known species appeared to represent a hitherto undescribed species under the genus.

Measurements of the fish given in parentheses in species description are the range of proportions and outside the parentheses are arithmatic mean of the range of proportions.

A detailed description of the new species to the Indian species of the genus is given.

Barilius howesi sp. nov.

Material: *Holotype* (Fig. 1): 70 mm. in standard length. Zoological Survey of India,

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[1] Accepted May 1985.

[2] Zoological Survey of India, Calcutta.

Calcutta, FF 2235. Locality: stream near sulkapara, Jalpaiguri district (North Bengal), West Bengal, Collector: Dr. H. K. Bhowmick. Date of Collection: 27.8.1975. *Paratypes*: 2 exs., 61 mm.-66 mm. in standard length. Reg. No. Zoological Survey of India, Calcutta. FF. 2236. Locality: Collector and date of collection same as in holotype.

Etymology

For Dr. G. J. Howes of the British Museum (Natural History), London, in recognition of his contributions to systematics of bariline cyprinid fishes.

DIAGNOSIS

Head length 4.35-4.71 and body depth 3.00-3.25 in standard length. Eye diameter 4.00-4.29 in head length. Least depth of caudal peduncle 1.62-1.71 in its length. Lateral line scales 43-45. Lateral vertical bands 14 or 15. Barbels 2 pairs, anterior pairs of barbels longer than posterior pairs of barbels.

DESCRIPTION

Head length 4.50 (4.35-4.71) at the most distant point on the opercular membrane, body depth 3.12 (3.00-4.25) at the origin of pelvic fin, predorsal distance 1.74 (1.73-1.75), prepelvic distance 1.96 (1.94-2.00), preanal distance 1.39 (1.37-1.45) and length of caudal fin 4.37 (4.06-4.66) in standard length. Depth of head 1.15 (1.14-1.16) at the occiput and width of head 1.83 (1.76-1.88) at its widest point in head length. Snout length 4.15 (4.00-2.28) in head length, 1.40 (1.28-1.57) in interorbital width. Eye diameter 4.14 (4.00-4.29) in head length, 1.34 (1.28-1.37) in interorbital width. Length of the postorbital part of the head is twice that of the preorbital part of head (snout length). Cleft of mouth wide, extending below middle of eye. 2 pairs of barbels, anterior pair 2.33 (2.00-2.66) and posterior pair, 3.27 (2.33-4.00) in eye diameter. Least depth of caudal peduncle 1.65 (1.62-1.71) in its length.

Scales: Lateral line scales 43-45. Lateral transverse scales 12; 8½ between origin of dorsal fin and lateral line, 3½ between origin of pelvic fin and lateral line. 20-21 predorsal and 14 curcumpeduncular scales.

Fins: D. ii, 8; A. iii, 9; P. i, 13; V. i, 8; C. 19. Dorsal commences opposite interspace between pelvic and anal fin, nearer to tip of snout than to base of caudal fin extending over the half length of anal fin. Pelvic originates on a vertical anterior to the dorsal fin. Length of longest dorsal ray 5.62 (5.50-5.83), length of longest anal ray 7.29 (6.77-7.77), pectoral length 4.93 (4.71-5.08) and pelvic length 7.30 (6.94-7.62) in standard length. Caudal fin deeply forked with lower lobe slightly longer than upper one. Pectoral, pelvic and anal fins are all widely spaced.

Colour in alcohol: Dorsal surface brown, sides and ventral surface silvery white. Sides of trunk and caudal peduncle with 14 or 15 vertical dark bands, much narrower than the pale interspaces. Dorsal, anal, pectoral and pelvic fins are hyaline coloured.

Habitat and Distribution: The new species was collected from a stream near Sulkapara, Jalpaiguri district (North Bengal), West Bengal, India which lies between 26°-27° N latitude and 88°-89° E longitude.

RELATIONSHIPS

Barilius howesi is closely related to *Barilius barna* (Hamilton) and *Barilius barila* (Hamilton). The new species can be easily separated from the former species in its shorter head length 4.35-4.71 vs. 3.68-4.00 and greater body depth 3.00-3.25 vs. 3.50-4.00 in standard length; shorter eye diameter 4.00-4.29 vs. 2.50-3.50 in head length; more numerous predorsal scales 20-21 vs. 15-16; more vertical bars 14-15 vs. 9-10.

The new species can be also distinguished from *B. barila* in having a shorter head length 4.35-4.71 vs. 3.90-3.93 and greater body depth 3.00-3.25 vs. 4.77-5.22 in standard length; shorter eye diameter 4.00-4.29 vs. 3.50-4.00 in head length.

ACKNOWLEDGEMENTS

I would like to thank Dr. B. K. Tikader, Director, Zoological Survey of India, Calcutta for laboratory facilities and to Dr. K. C. Jayaram, Joint Director for his encouragement. I am grateful to Dr. G. J. Howes of the British Museum (Natural History), London for going through the manuscript critically and for his many valuable suggestions for modifications. I am also thankful to Dr. P. K. Talwar, Superintending Zoologist for his encouragement and to Mr. D. Pyne, Departmental Artist who has drawn the figure.

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A NEW SPECIES OF *RHYNOCORIS* (FABRICIUS) FROM SOUTHERN INDIA (HETEROPTERA-REDUVIIDAE-HARPACTORINAE)[1]

DUNSTON P. AMBROSE[2] & DAVID LIVINGSTONE[3]

(*With six text-figures*)

A new species of *Rhynocoris* (Fabricius) *viz., R. kumarii* sp. nov. is described and illustrated. A key for the identification of Indian *Rhynocoris* species is formulated.

Rhynocoris kumarii sp. nov.

Antennae bright red except the base of the scape, rostral tip, eyes, membranes, scutellum, apices of tibiae, tarsomers, abdomen above and beneath black, posterior lobe of pronotum with two pairs of ferruginotestaceous bands running parallel. (Figs. 1-6).

Head finely pubescent, moderately elongate and shorter than pronotum, anteriorly unarmed, a median transverse impression in between eyes dividing the head into almost equal anteocular and postocular areas, anteocular area

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[1] Accepted September 1985.

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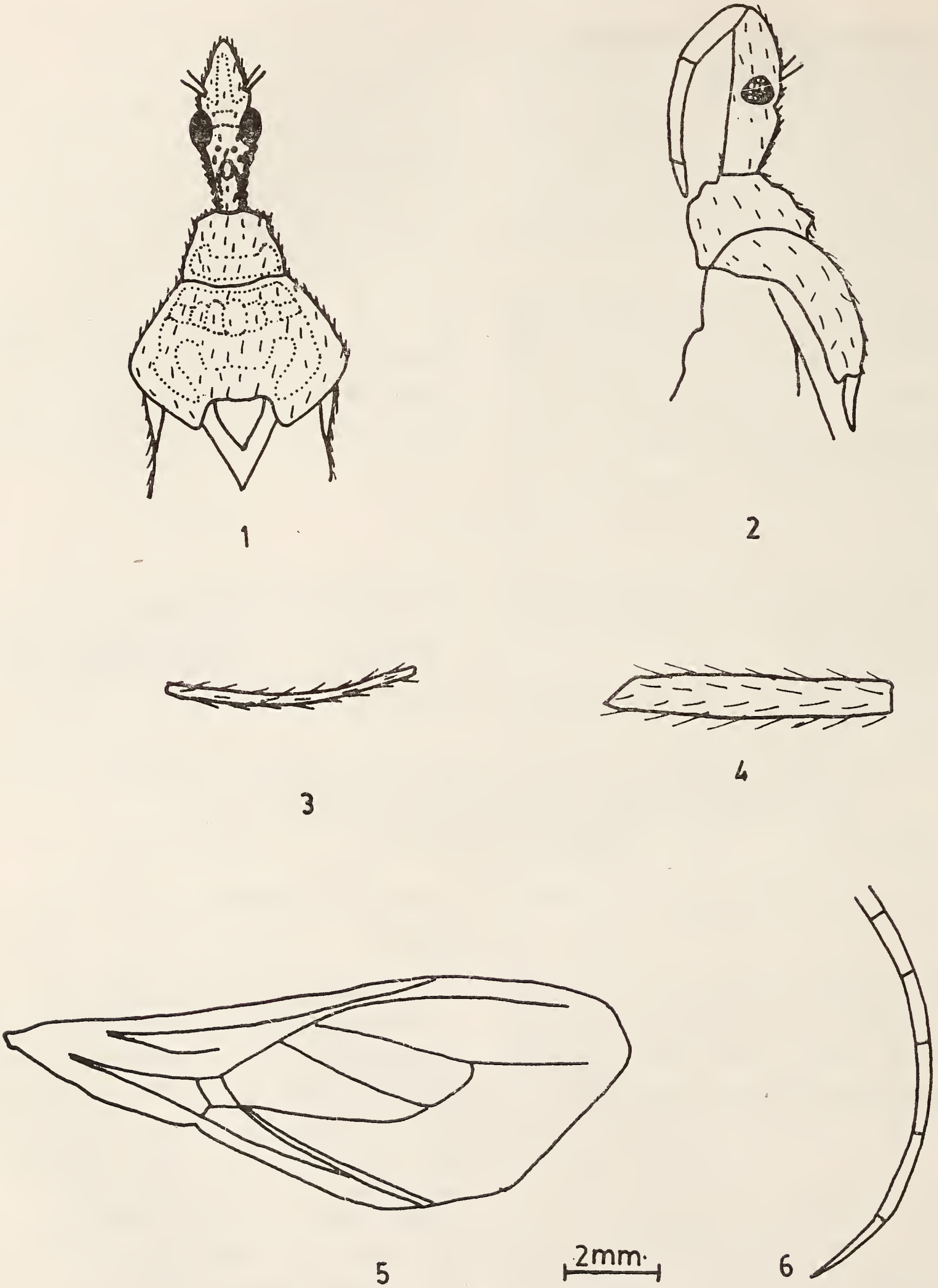

Figs. 1-6. *Rhynocoris kumarii* sp. nov.
1. Head, pronotum and scutellum dorsal view; 2. Head, pronotum and scutellum lateral view; 3. Basal antennal segment (scape); 4. Fore femur; 5. Hemelytron; 6. Connexivum.

possessing a median elevated region ending bluntly anteriorly immediately behind the transverse impression at the posterior inner margin of eyes; a pair of coral red ocelli; filamentous antennae four segmented, scape the longest, pedicel and first flagellar segments shortest and almost equal in length, first joint of antennae shorter than anterior femora; three segmented crescentic rostrum reaching prosternal furrow while at rest, third segment shortest, second segment slightly onger than first, basal joint passing apex of eyes.

Prothorax pubescent, a transverse constriction dividing the prothorax into an anterior shorter globose lobe and posterior slightly convex longer lobe, anterior lobe rugulose and sculptured delimiting a narrow collar anteriorly bearing a marginal tubercle laterally, a median longitudinal sulci and two lateral sulci running obliquely towards posterior lobe; posterior lobe rugulose and highly granulate devoid of spinous tubercles, possessing narrow paranotal deflections, posteriorly subnodulose; small triangular scutellum bearing short tuberculate scutellar spine, prothorax width greater than its width; corium rugulose, wings not covering the entire abdomen but medially extending slightly beyond the abdomen, abdominal segments exposed laterally, legs richly pilose, tibial pads rudimentary in all three tibiae, fore tibia with subapical tibial spur, mid leg the shortest and hind leg the longest, paired scent gland orifices prominently placed laterally on the dorsum of first abdominal segment, convexivum distinctly deflexed.

Table 1

Mean values of (x ±SE) morphometric analyses of females of *Rhynocoris marginatus* and *R. kumarii* (n = 10)

No.	Characters	of females of *Rhynocoris marginatus* and *R. kumarii*	
1.	Length of anteocular area	1.59±0.05	1.8±0.07
2.	Length of Portocular area	1.77±0.02	1.85±0.05
3.	Width between eyes	0.94±0.03	1.12±0.03
4.	Diameter of eye	0.8 ±0.02	0.86±0
5.	Length of scape	4.29±0.12	5.68±0.27
6.	Length of pedial	2.35±0.07	2.52±0.07
7.	Length of first flagellar segment	2.04±0.05	2.69±0.03
8.	Length of secured flagellar segment	3.06±0.04	4.38±0.04
9.	Length of first rostral segment	1.98±0.08	2.08±0.1
10.	Length of second rostral segment	2.81±0.08	2.57±0.08
11.	Length of third rostral segment	0.68±0	0.66±0.02
12.	Length of prothorax	4.58±0.09	4.53±0.18
13.	Width of prothorax	5.37±0.14	5.13±0.07
14.	Length of fore tibia	6.48±0.13	6.97±0.15
15.	Length of mid tibia	5.42±0.14	6.11±0.15
16.	Length of hind tibia	8.05±0.17	9.19±0.22
17.	Length of wing	12.17±0.17	11.48±0.19
18.	Width of wing	5.24±0.1	5.11±0.07
19.	Length of abdomen	9.28±0.31	8.56±0.44
20.	Width of abdomen	7.03±0.34	7.25±0.28

Length 19 mm, width across pterothorax 4.75 mm.

Holotype (Female, Reg. No. 9, Insect collection, Division of Entomology, Bharathiyar University, Coimbatore, India) and paratypes were collected from Maruthuvazhmalai scrub jungle, one of the legendary hillocks of Asia in Kanyakumari district, Tamil Nadu by the Senior Author (Ambrose 1980) on 23.ii.1977.

KEY FOR THE IDENTIFICATION OF INDIAN SPECIES OF GENUS *Rhynocoris*

1. Posterior lobe of pronotum rugosely granulate 2
Posterior lobe of pronotum not or very obscurely rugosely granulate 4

2. Legs unicolourous 3
Legs not unicolourous .... *R. marginatus* (Fabricius)

3. Black, entire legs piceous .... *R. squalus* (Distant)
Bright red, entire legs bright red ....*R. kumarii* sp. nov.

4. Head as long as or about as long as pronotum 5
Head longer than pronotum .... *R. longifrons* (Stal)

5. First joint of rostrum not or scarcely longer than anteocular area of head 6
First joint of rostrum distinctly longer than anteocular area of head 9

6. Membrane passing abdominal apex 7
Membrane not passing or very slightly passing abdominal apex 8

7. Coral red, pronotum with anterior lobe distinctly sculptured .... *R. fuscipes* (Fabricius)
Black, pronotum with anterior lobe very obscurely sculptured .... *R. costalis* (Stal)

8. Dull reddish ochraceous, membrane not passing abdominal apex .... *R. erythropus* (Linnaeus)
Coral red, membrane very slightly passing abdominal apex .... *R. moeandrus* (Distant)

9. Pronotal lobe concolorous 10
Pronotal lobe not concolorous, posterior lobe luteous 12

10. Postocular area longer than anteocular area.... .... *R. tristicolor* (Reuter)
Ante and postocular areas of head about equal in length 11

11. First joint of antennae little shorter than anterior femora, anterior lobe of pronotum broadly centrally impressed .... *R. reuteri* (Distant)
First joint of antennae about equal length to anterior femora, anterior lobe of pronotum posteriorly centrally impressed .... *R. marginellus* (Fabricius)

12. Abdomen beneath fasciated with black .... *R. flavus* (Distant)
Abdomen beneath unicolorous 13

13. First joint of rostrum reaching posterior margin of eyes .... *R. nigricollis* (Dall)
First joint of rostrum not reaching posterior margin of eyes 14

14. Posterior pronotal lobe sanguineous .... *R. nigriensis* (Distant)
Posterior pronotal lobe luteous .... *R. pygmaeus* (Distant)

DISCUSSION

R. kumarii sp. nov. is closely similar to *R. marginatus* Fabricius in having the following characters: anteocular and postocular areas of head about equal in length, basal joint of rostrum reaching eyes, pronotum with anterior lobe sculptured and posterior lobe rugulose, corium rugulose and transverse cell near base of membrane margined with membrane passing abdominal apex.

R. kumarii sp. nov. can be differentiated from *R. marginatus* by the bright red colour and entire bright red legs except the tarsomeres and other morphometric analyses (Table 1).

ACKNOWLEDGEMENTS

We are grateful to the authorities of the University of Madras PG Centre, Coimbatore for providing facilities. One of us (DPA) is grateful to the C.S.I.R. New Delhi for financial assistance during the course of this investigation.

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ON A NEW SUBSPECIES OF *CHAGUNIUS CHAGUNIO* (HAMILTON-BUCHANAN) (PISCES: CYPRINIDAE) FROM BURMA[1]

P. K. Talwar and A. Das[2]

(*With a text-figure*)

A new subspecies of the cyprinoid fish, *Chagunius chagunio* (Hamilton-Buchanan) is described from Burma and its affinities with the 'forma typica' discussed.

INTRODUCTION

The monotypic genus *Chagunius* was established by Smith (1938) for the interesting and strongly characterised cyprinoid fish *Cyprinus chagunio* Hamilton-Buchanan, 1822. This species having a wide range along the base of the Himalayas (Day 1877, 1889), was added to the Burmese fauna (as *Barbus chagunio*) by collections made by Dr. B. N. Chopra during 1926 from Upper Burma (Prashad & Mukerji 1929) and later to the Thai fauna by Smith (1938).

During the course of our studies on the ichthyofauna of Burma, it was noticed that the two specimens of *Barbus chagunio* from Upper Burma (ZSI regd. no. F10909/1) reported on by Prashad & Mukerji (1929), and also the specimen collected from Upper Burma by Lt.-Col. R. W. Burton (ZSI regd no. F 11465/1) reported on by Mukerji (1934), have several marked distinctive features which deserve expression in nomenclature. The trenchant differences between the Burmese and Indian material studied here are uniform and separate the two at a subspecific level. *Chagunius chagunio* was originally described from the Yamuna and the northern rivers of Bihar and Bengal by Hamilton-Buchanan (1822). The new subspecies is named in honour of Dr. Baini Prashad, in recognition of his contributions to the systematics of Burmese fishes.

SYSTEMATIC ACCOUNT

Family: CYPRINIDAE

Chagunius chagunio prashadi subsp. nov.

Barbus chagunio (*nec* Hamilton-Buchanan) Prashad & Mukerji, 1929, *Rec. Indian Mus.*, *31*(3): 195; Mukerji, 1934, *J. Bombay nat. Hist. Soc.*, *37*(1): 67.

Material: Holotype (Text-fig. 1) 200 mm standard length, Nam Kawng Chaung stream at Kamaing (Myitkyina District, Upper Burma), *coll.* B. N. Chopra, Nov.-December 1926; ZSI regd no. FF 2192.

Paratypes (i) a specimen, 190 mm SL., same data as holotype; ZSI regd no. FF 2193.

(ii) a specimen, 117 mm SL., Phungin Hka, a tributary of Mali Hka R. (Myitkyina District, Upper Burma), *coll.* R. W. Burton, 1930; ZSI regd no. FF 2194.

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[1] Accepted May 1985.

[2] Zoological Survey of India, 27 Jawaharlal Nehru Road, Calcutta-700 016.

Description: Based on the holotype and two paratypes. Meristic counts and morphometric measurements are presented in the table 1.

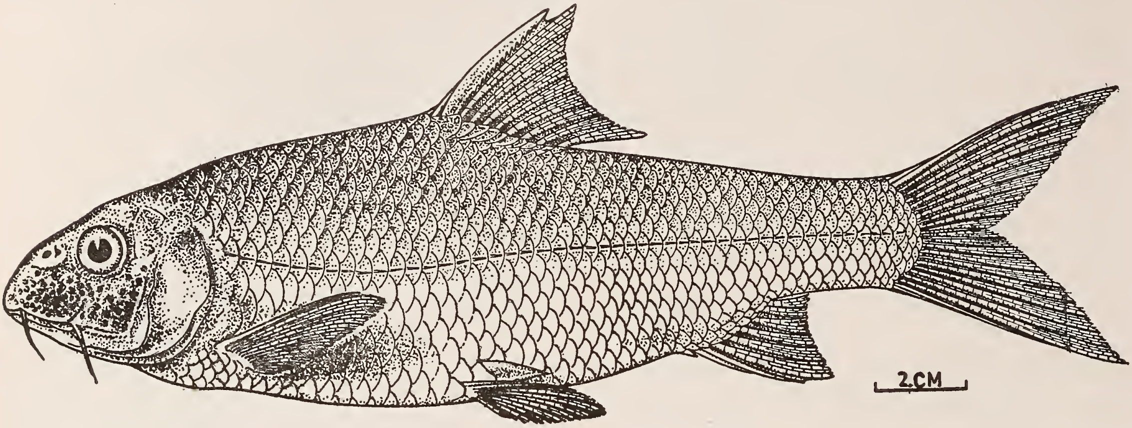

Fig. 1. *Chagunius chagunio prashadi* subsp. nov.

Body elongated and considerably compressed. Head much compressed, with flat sides. Eyes large, its diameter 4.0-4.8 in length of head; interorbital broad, its width more than eye-diameter. Mouth large, subinferior; lips thick, fleshy and papillose, continuous around corners of mouth, closely investing jaws; lower lip sharply defined by a long, deep, straight, posterior groove which does not extend to median line of chin. Pharyngeal teeth 5, 3, 2 - 2, 3, 5. Snout slightly overhanging the mouth, its free pendant border covering base of upper lip; snout divided into a central and two lateral lobes by a groove extending upward and forward from the base of each rostral barbel. Barbels two pairs (rostral and maxillary), well developed, almost equal in length but the rostral pair is more slender. Gill-membranes narrowly joined to isthmus; gill-rakers on lower arm of first arch 9 fleshy triangular plates.

Dorsal fin inserted slightly in advance of pelvic fins, nearer the tip of snout than the caudal-fin base, with 13 rays (8 branched), the last simple ray osseous and coarsely serrated, the first two simple rays are minute and embedded in the skin. Anal fin with 8 rays (5 branched). Pectoral fin with 15 rays. Pelvic fin with 10 rays (8 branched), its first

TABLE 1

	Holotype	Paratypes	
	FF 2192	FF 2193	FF 2194
Dorsal f.r.	v 8	v 8	v 8
Anal f.r.	iii 5	iii 5	iii 5
Standard length	200	190	117
Body depth	65	59	35
Head length	48	45	30
Eye diameter	12	11	8
Snout length	20	18	13
Interorbital width	18	17	10
Length of upper jaw	16	15	9
Length of lower jaw	21	19	12
Pectoral fin length	38	35	21
Pelvic fin length	33	29	19
Length of dorsal-fin spine	34	33	22

simple ray very small and firmly attached to the second ray; pelvic fins with well developed scaly appendants. Candal fin forked. Scales large; lateral line complete, with 46 or 47 scales, 1.tr.9/5; predorsal scales 14. Snout and cheeks beset with short horny tubercles.

Colour: in alcohol, silvery glossed with gold with the scales towards the back darkest at their bases; a blackish band just behind the operculum which passes from the base of pectoral fin to the nape.

DISCUSSION

Chagunius is a well-defined monotypic genus and closely allied to *Puntius* Hamilton-Buchanan from which it may be distinguished in having the snout divided into a median and two lateral lobes, and the presence of horny tubercles on the snout and cheeks (Smith 1945, Jayaram 1981). There has been a certain amount of confusion regarding the identity of the type-species, *Cyprinus chagunio* Hamilton-Buchanan and the subject has been discussed in detail by Hora (1928), and Hora & Mukerji (1933) who have shown that the species is sexually dimorphic.

Chagunius chagunio was added to the Burmese fauna by Prashad & Mukerji (1929) who gave a short description of the two specimens collected from Upper Burma by Dr. B. N. Chopra during 1926. The measurements given by Prashad & Mukerji (1929) are slightly at variance with those taken by us of the same material, probably this is mainly due to differences in method of measuring; the base of the caudal fin is difficult to find, and, moreover, slight changes may have occurred during preservation. Subsequent to this collection, Mukerji (1934) reported on another specimen from Upper Burma. These three specimens of *Chagunius chagunio* have now been found to belong to an undescribed subspecies. This Burmese subspecies has been compared with the 'forma typica' which is well-represented in the ZSI collections.

The Burmese subspecies may be distinguished from the Indian *C. chagunio* in having a smaller head (3.9-4.2 *vs* 3.5-3.7 in Standard length), and shorter pectoral and pelvic fins (5.2-5.8 *vs* 4.3-5.0, 6.2-6.9 *vs* 4.9-5.9 respectively, both in Standard length). Besides these, the new subspecies has fewer scales in the lateral transverse series (9/5 *vs* 11/9); the barbels are almost equal in length whereas in the Indian *C. chagunio* the maxillary barbels are longer than the rostral; and further, the dorsal fin is slightly more anteriorly placed in the new subspecies, being nearer (*vs* midway) the tip of snout than the caudal-fin base. The new subspecies was observed to be fairly common in the Nam Kawng Chaung at Kamaing (Upper Burma) by Dr. B. N. Chopra (Prashad & Mukerji 1929). As a consequence of this study it may be concluded that the Indian *Chagunius chagunio* has a wide range along the base of Himalayas only and its occurrence in Pakistan even is doubtful (Mirza 1975).

ACKNOWLEDGEMENTS

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THREE NEW SPECIES AND A NEW VARIETY OF MONOCOTYLEDONS FROM SAVANTWADI, MAHARASHTRA[1]

S. M. ALMEIDA[2]

(*With two plates & four text-figures*)

During the floristic studies of Savantwadi taluka, Sindhudurg Dist, Maharashtra, I came across a number of interesting plants. Critical studies on these specimens at Blatter Herbarium, has revealed three new species and a new variety.

1. **Pycreus bolei** sp. nov.

Herba cespitosa ± 30 cm alta foliis linearibus costis prominentibus fuscis. Inflorescentia spicis compactis sessilibus stellatis linearibus stramineis bractatis. Glumae ovatae aristatae carinatae. Stamina dua parva filamentis tenuibus. Nux oblanceolata apiculata compressa paginis tuberculatis longitudinalibus.

Rare in oryzae aperis agribus.

Holotypus: SMA-3438, lectus Satarda — Savantwadi 22-10-1980.

Similis *Pycreo globoso* (All.) Reich externo aspectu sed differt spiculis acuminatis facile separabilibus et rhachide plana et parvis staminibus.

Tufted herb, ± 30 cm tall. Stems striate. Leaves flat, 27-30 cm long, linear, narrowing to the apex, glabrous with prominent brown midrid. Inflorescence of compact, sessile, stellate, linear spikes, bracteate. Rays 3-4 in

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[1] Accepted June 1985.

[2] Blatter Herbarium, St. Xavier's College, Bombay-400 001.

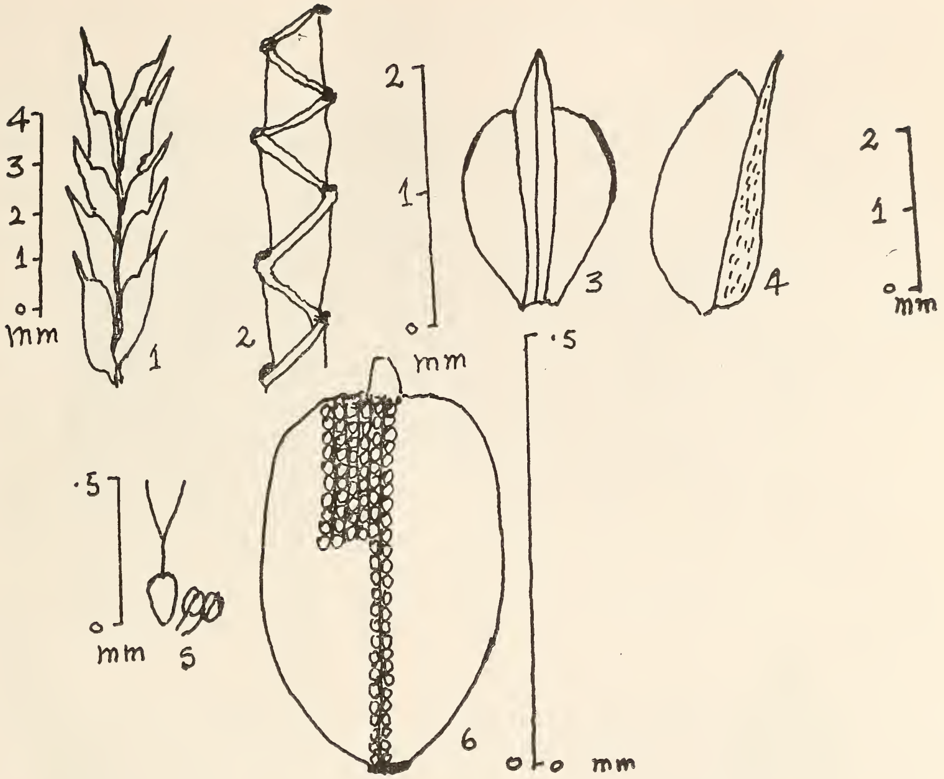


Fig. 1. *Pycreus bolei* sp. nov.: 1. Spikelet; 2. Rachis; 3. Glume (back view); 4. Glume (side view); 5. Pistil & Stamens; 6. Nut.

number, 4.5-5 cm long, slender, glabrous. Bracts 4-5, glabrous, leaf-like with prominent midrib, 15-20 cm long, 2-3 mm wide, imbricating at the base, curling at the apex after drying. Spikes linear, sessile, 0.7-1.3 cm long, 0.2-0.3 mm wide, straw coloured with 25-40 spikelets. Rachilla not winged, glabrous. Glumes ovate, 0.5-1 mm long, 0.5-0.7 mm wide, aristate, keeled. Keels brown, hyaline on the margins. Stamens 2, small, with slender filaments. Ovary oblanceolate; styles as long as ovary; stigmas 2, equal to the length of the style. Nut oblanceolate, compressed, shortly apiculate, marked with longitudinal rows of tubercles on the surface.

Rare herb in open paddy fields near river banks.

Flowering: October-November. *Locality*: Satarda (Savantwadi).

Holotype: SMA — 3438.

Pycreus bolei sp. nov. resembles *Pycreus globosus* (All.) Reich. in external appearance, but differs from it in the presence of easily detachable, acuminate spikelets and also in the presence of flat rachis and small stamens.

This species is named after Prof. P. V. Bole, for the guidance and encouragement

shown during my taxonomc studies on Flora of Savantwadi.

2. **Pycreus lancelotii** sp. nov.

Annua 5-8 cm alta cespitosa foliis radicalibus costis crassis et 5-6 venis prominentibus lateralibus in base. Inflorescentia eius spicis compactis in capitibus. Spicae distichae cinerascentes. Spiculae oblongae naviculares carinatae; carinae brunneolae spectantes rhachillas. Fila plana staminum longiora pistillo. Nux oblanceolata paginis spisse tuberculatis.

Rare in humidis agribus ozyzae.

Holotypus: SMA-162, lectus Charatha — Savantwadi, 25-5-1977.

Similis *Juncello pygmaeo* (Rettb.) Clarke (= *Cyperus pygmaeus* Rottb.) externo aspectu sed differt spiculis distichis et carinis alatis destitutis.

Similis est *P. bolei* sp. nov. externo aspectu sed rhachide prominenti cylindrica destituta et habens carinas brunneolas spectantes rhachillam at fila plana longiora pistillo ad maturitatem.

Tufted annual, 5-8 cm tall, with number

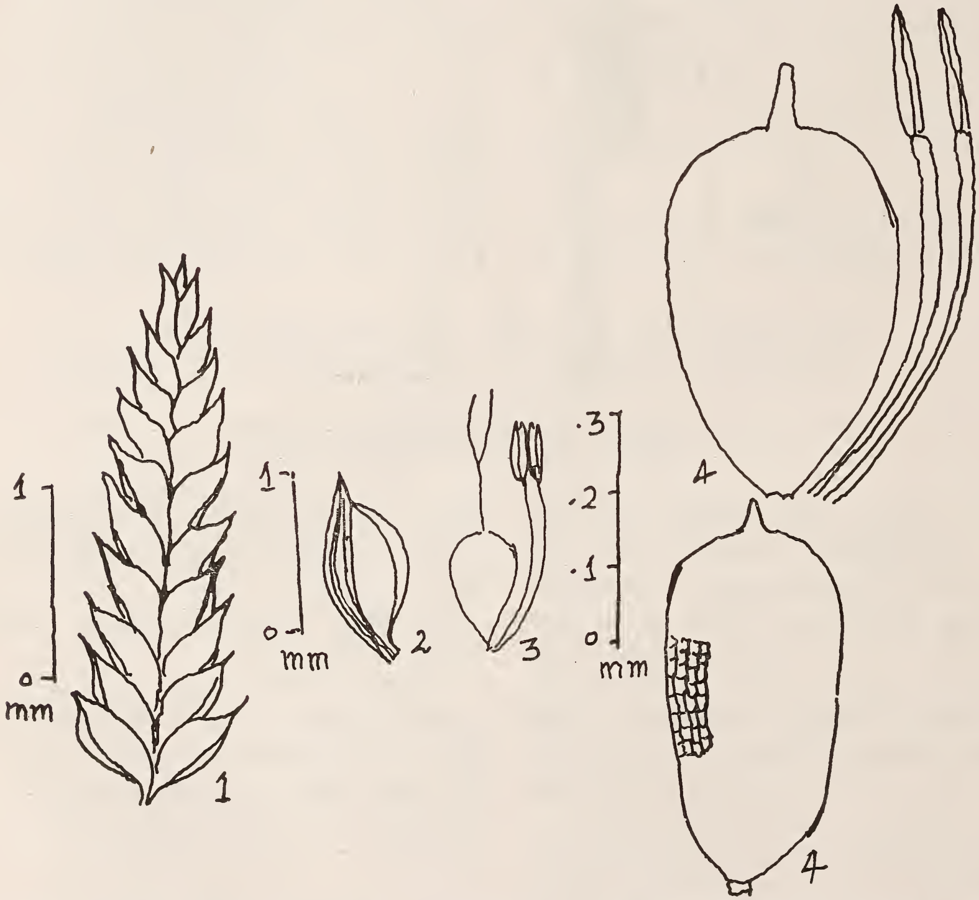
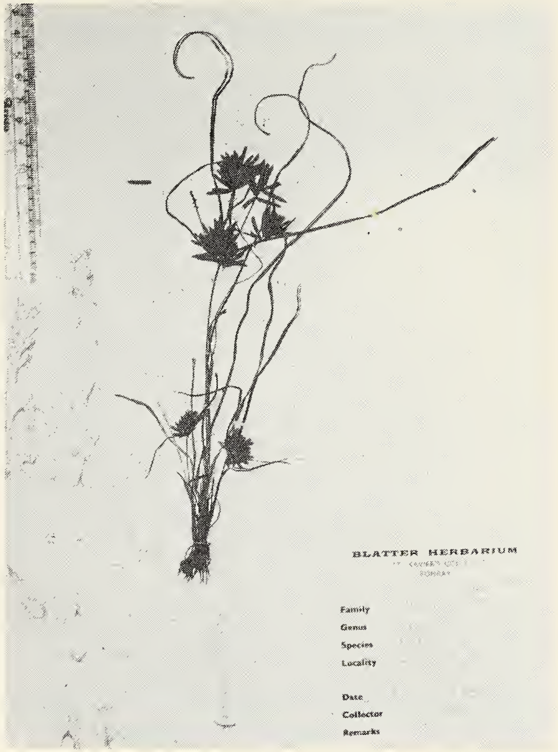


Fig. 2. *Pycreus lancelotii* sp. nov.: 1. Spikelet; 2. Glume; 3. Pistil and Stamens; 4. Variable shape of nuts; 4. Nut and mature stamens.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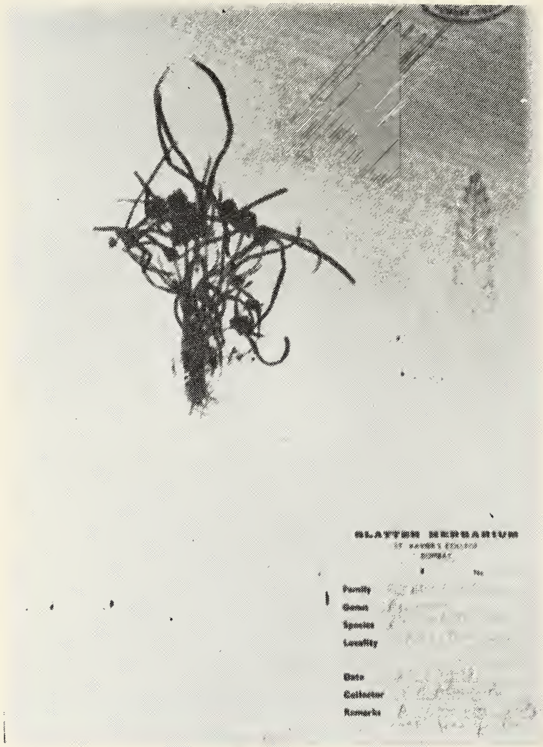
Family
Genus
Species
Locality
Date
Collector
Remarks

Pycreus bolei sp. nov. — Habit.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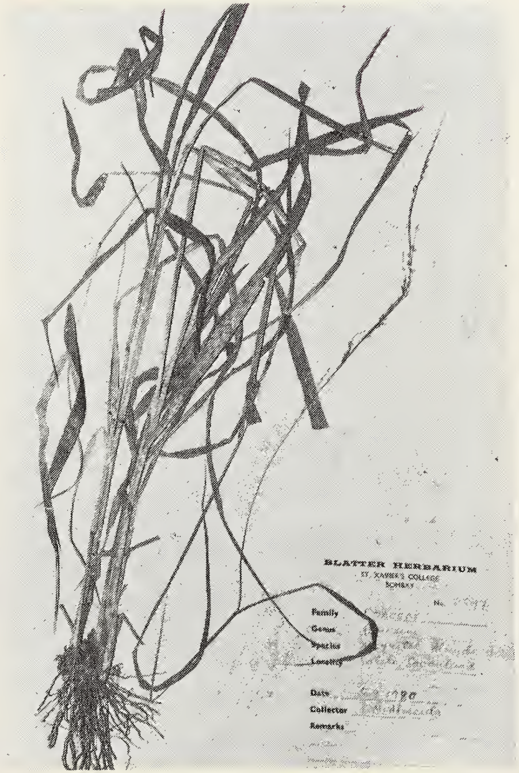
Pycreus lancelotii sp. nov. — Habit.

PLATE 2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ST. XAVIER'S COLLEGE
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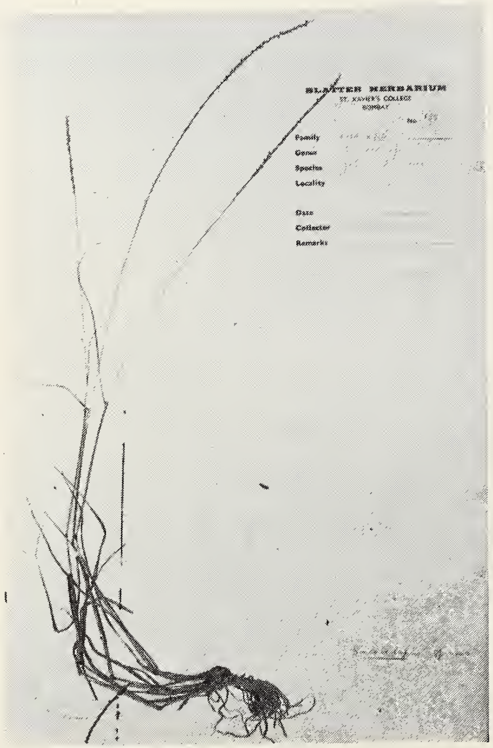
Panicum johnii sp. nov. — Habit.


BLATTER HERBARIUM
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No.
Family
Genus
Species
Locality
Date
Collector
Remarks

Sacciolepis indica (Linn.) Chase var. *intermedia* var. nov. — Habit.

of slender fibrous roots. Leaves radical, linear, flat, glabrous, 8-10 cm long, 1.5-2 mm broad, tapering to the apex, broader at the base with thick mid-vein and 5-6 prominent lateral veins at the base; margins thick. Scape 5-7 cm long, dull grey, striate, flat, glabrous. Inflorescence of compact spikes forming heads, bracteate. Bracts 3-4, leaf-like, imbricating, much exceeding the rachis, 6-8 cm long, 1-2 mm broad at the base, narrowing to the apex to a point. Midrib thick and prominent, lateral veins faint. Margins thick, glabrous. Rays 3-5 in number, 1-1.5 cm long, striate, glabrous. Spikes radiating, dull grey, distichous. Spikelets oblong, compactly arranged on rachilla, boat-shaped, acute, glabrous, keeled; keel membranous and hyaline on the sides facing the rachilla, brownish towards outside. Stamens 2, much longer than the ovary, projecting beyond the style on maturation; anthers linear; filaments flat. Ovary obovoid; style slender; stigma 2-fid. Nut oblanceolate, shortly beaked, with compactly arranged tubercles on the surface.

Rare sedge in wet rice fields.

Flowering: May. *Locality*: Charatha (Savantwadi)

Holotype: SMA-162.

Pycreus lancelotii sp. nov. resembles *Juncellus pygmaeus* (Rottb.) Clarke (=*Cyperus pygmaeus* Rottb.) in external appearance, but differs from it in the distichous arrangement of spikelets on the rachis and in the absence of winged keel of the spikelets. *P. lancelotii* also

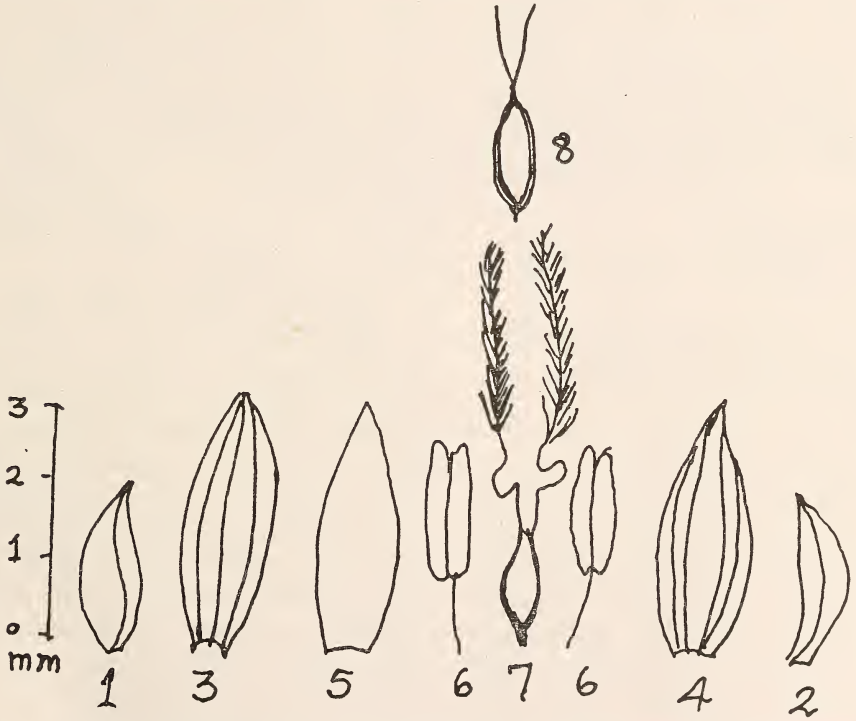

Fig. 3. *Panicum johnii* sp. nov.: 1. Outer glume; 2. Inner glume; 3. Outer lemma; 4. Inner lemma; 5. Palea; 6. Stamens; 7. Pistil; 8. Caryopsis.

resembles *P. bolei* sp. nov. in external appearance, but differs from it in the absence of prominent cylindrical rachis and in the presence of long stamens with flattened filaments and linear anther lobes which project beyond the style on maturation.

This species is named after Rev. Fr. Lancy Pereira, ex-principal, St. Xavier's College, Bombay for his enthusiasm in advancement of science and encouragement I received from him during my studies.

3. **Panicum johnii** sp. nov.

Annua cespitosa ± 90 cms alta. Caulis striatus nodis et internodia prominentibus; regio nodus brunnea. Folia linearia costis prominentibus; ligula 5-6 pilis nonramosis. Inflorescentia eius spicis terminalibus tenuibus racemosis. Rahachis sulcata. Spiculae 2-3 mm longae, 1 mm latae, acuta apice solitariae, articulatae cadentes ad maturitatem. Pedicelli persistentes, glumae externae naviculares 5-nervi tribus prominentibus; glumae interiores 4-nervi lanceolati. Caryopsis oblonga stylis persistentibus.

Rare in agribus oryzae.

Holotypus: SMA-2597, lectus Sateli — Savantwadi 5-9-1980.

Similis *Panico repente* Linn. externo aspectu, sed differt spicis tenuibus racemosis.

Similis etiam *Panico paludoso* Roxb. externo aspectu, sed differt spiculis acutis et rhachidibus sulcatis decrescentibus apice.

An erect, tufted annual ± 90 cm tall with number of fibrous roots. Stems stout, striate with prominent nodes and internodes; internodal region brown. Leaves linear, ± 30 cm long with prominent mid-veins, narrowing to the apex; ligule of 5-6 unbranched hairs; petiole sheathing, 5-7 cm long. Inflorescence of terminal, slender, racemose spikes. Rachis grooved, glabrous, 27-30 cm long, narrowing to the apex. Spikelets small, 2-3 mm long, 0.7-1 mm wide, acute at the apex, solitary, articulate, falling entirely at maturity. Pedicel persistent. Outer glume boat-shaped, 5-nerved; 3 nerves prominent, 2 faint. Inner glume 4-nerved, lanceolate, transparent. Stamens 1-2; anthers linear; filaments very short. Ovary oblong; styles 2; stigmas 2, plumose. Caryopsis oblong, compressed with persistent style bases.

Rare weed in rice fields.

Flowering: September-October.

Locality: Sateli (Savantwadi).

Holotype SMA-2597.

Panicum johnii sp. nov. comes very close to *P. repens* Linn. in external appearance, but differs from it in the presence of slender racemose spikes. It also comes very near to *Panicum paludosum* Roxb. in external appearance, but differs from it in the presence of stout, grooved rachis narrowing to the apex and in the presence of acute spikelets.

This species is named after Rev. Fr. John Correia Afonso, S.J. ex-principal, St. Xavier's College, Bombay for his keen interest in the research activities of Blatter Herbarium and Botany Department.

4. **Sacciolepis indica** (Linn.) Chase var. **intermedia** var. nov.

Gramen gracile ± 45-60 cm altum ramosum e basi. Culmi 3-4 internodis, nodis brunneis et hispidis. Folia acicularia multinerva. Inflorescentia eius debita spicis terminalibus nonramosis solitariis compressis paniculatis. Spiculae lanceolatae articulatae dispositae duabus seriebus in pedicellis inaequalibus ad rhachidem appressis cadentes ad maturitatem; pedicelli persistentes spiculis manifeste articulatis. Flosculi unisexuales.

Rare gramen in humidis locis.

Holotype: SMA-1393, lectus Charatha — Savantwadi, 31-12-1977.

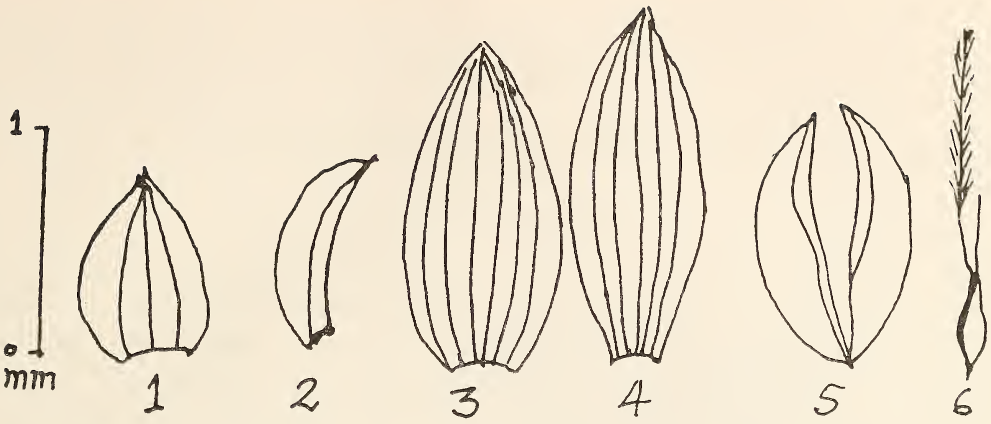

Fig. 4. *Sacciolepis indica* (Linn.) Chase var. *intermedia* var. nov.: 1. Outer glume; 2. Inner glume; 3. Outer lemma; 4. Inner lemma; 5. Paleas; 6. Pistil.

Similis *Sacciolepi indica* (L.) Chase in characteribus floralibus at externo aspectu differt in pedicellis longioribus spiculis acutis et squamis destituta.

Slender grass, ± 45-60 cm tall (including inflorescence) with 4-5 branches from the base having number of fibrous roots. Culms slender, with 3-4 internodes; nodes brown, hairy. Leaves linear, with sheathing leaf bases; leaf bases of basal leaves 3-4 cm long, 4-5 mm broad, many nerved; lamina 12-15 cm long, acicular. Inflorescence of terminal, unbranched, solitary, compressed, paniculate spikes. Rachis 13-15 cm long, striate. Spikelets lanceolate, bracteate, appressed to the rachis, alternate, arranged in twos on unequal pedicels, articulated, falling off at maturity. Pedicels persistent with prominent articulations of the spikelets. Outer glumes ovate, acute, 1-1.5 mm long, strongly veined; inner glumes 2, ovate-lanceolate, 3-4 mm long, longer than the outer glume, acute, strongly veined, purple. Palea ovate, membranous, 2-2.5 mm long, 1.5-2 mm broad; lemma same as that of palea. Florets unisexual. Male florets with 3 stamens; filaments small; female florets with oblong, compressed ovary; styles 2, equal, slender.

Rare grass in moist places.

Flowering: December-January.

Locality: Charatha (Savantwadi).

Holotype: SMA-1393.

Sacciolepis indica (Linn.) Chase var. *intermedia* var. nov. comes very near to *Sacciolepis indica* (L.) Chase in floral characters and in external appearance but differs from it in the presence of longer pedicels, acute spikelets and in the absence of scales.

ACKNOWLEDGEMENTS

I am grateful to the Principal, St. Xavier's College, Bombay; to Rev. Fr. Conrard Mascarenhas for the Latin diagnosis of the species; to the authorities of the Botanical Survey of India, Western Circle, Poona, for facilities offered to refer to the herbarium and library; to Prof. Bole for his guidance; to Mr. Almeida and to my colleagues for the help in preparing this article.

OBITUARY

RAOL SHREE DHARMAKUMARSINHJI

(1917-1986)

(*With a photograph*)

It might seem that sitting down to write an obituary for a person one has known for over four decades should be easy. It is not, because when it comes to sitting down and writing on the person one has known for so long, learned to respect and to love, one finds to ones dismay that one really did not know the departed individual as well as one might have been taken for granted as for instance we all individually and collectively have indeed, been taking everything of value on this Earth and only realising the terrible loss when there are short supplies and unavailability. This is what dawns on us as we start writing about Dharmakumarsinhji, or Uncle Bapa. His death has removed from our lives a great friend and a truly great naturalist. As we look back over the receding memory trail, Uncle Bapa stands out clearly and all the wonderful experiences shared with him are etched in sharp clarity. As young boys, his visits to Hingolgadh every monsoon were eagerly anticipated by us. Each winter a return visit to Bhavnagar and the sea coast was impatiently awaited and these were always too short and quickly over, for those were the times of strict protocol and guests could not stay longer than a certain period howsoever welcome they might be! While we indeed were fledgling ornithologists in our own right even in those early days it was Dharmakumarsinhji who guided us into the complexities of identifying waders during those sunny days at Hathab and the Bhavnagar Saltpans. It was he who fired our enthusiasm for exploring the islands of the Gulf of Kutch. It was he who encouraged and paid for a photographic trip by Lavkumar to Karwar after the Whitebellied Sea Eagles. But we anticipate.

Earlier, while we were still in the box camera stage, he presented us a SLR with telephoto lens and a fortress like hide made of teak! We owe a great gratitude to Dharmakumarsinhji for his encouragement and guidance in a venture which we were among the first Indians to take up and had we been able to spend more time after our photographic interests, we might well have become leaders in the field! Even so Shivrajkumar won the Loke Wan Tho Prize in the BNHS Centenary photographic competition. A good many of the photographs in SIXTY INDIAN BIRDS jointly authored by Dharmakumarsinhji and Lavkumar were taken by us under very primitive conditions and with quite inadequate photographic equipment.

For us, his death has been a very personal loss and we now know that his characteristic slow speech and loud, hearty laughter will never more be heard in Hingolgadh which he loved. We no longer can expect a card or a scribbled note congratulating us on some action, or providing some wry comment on happenings in the world. But more so, his death starkly highlights the terrible decline of all forms of wildlife which he loved and to protect which he spent a large part of his energies. We have been privileged to have seen for a short time the magnificent wildlife heritage of Gujarat, a heritage which, when he was born into the Bhavnagar princely family 70 years ago, people took for granted as indeed they did the trees, waters, and the clear air around them. That he should have grown into a sportsman is not surprising since in his day it was the thing done to go on shoots, it was the day of the field naturalist and the shikari, and prowesses were gauged by the number of duck you shot out of the winter skies, yet, it is to his credit that at that early time he had the making of a naturalist and a conservationist. He studied the birds, and all forms of animal life around him. What he did not know about them was not much worth knowing ! He could speak with equal confidence on the identity of a snake or a frog as he would his beloved raptors ! His knowledge of falconry was legendry and only surpassed perhaps by his elder brother the highly respected Maharaja Krishnakumarsinhji. He had a keen eye and even in later years, sitting relaxed on the terrace at Hingolgadh he would spot a chinkara at the far end of the sanctuary, or point to an eagle high overhead which to us would be a mere speck.

If he was an excellent shot, he also anticipated modern birdbanding in India and with the Maharaja of Dholpur, was the first Indian to start ringing birds. Dharmakumarsinhji's work with the Lesser Florican is reported in the Journal. Infact, the Lesser Florican and the Great Indian Bustard were an infatuation with him and his contribution in highlighting the plight of these magnificent species must be recorded with due humility. It was indeed, a fitting tribute that the Rajasthan Government recognised for his work on the Great Indian Bustard by awarding him a "Tamra Patra" (Copper inscription) in the evening of his life. That Dharmakumarsinhji's impact on the natural history scene is not as sharp as it might be is because he, unfortunately was not a trained scientist and perhaps that he, born a Prince, saw no compunctions to record and

Raol Shree Dharmakumarsinhji
(1917-1986)

weigh and measure all — regretfully for us all, he took his expertise and his great knowledge for granted or perhaps being born and brought up as a sporting Prince, like the lion which he did much to preserve, he was a trifle too relaxed and so opportunities sped past and time seldom gives a second chance. This sadly, is the story of conservation action in our country, and today, if much indeed has been done, not enough is being done and those who are younger and still have the time, must make this an occasion to put in much more concern and effort to save the tattered remnants of Dharmakumarsinhji's world.

Dharmakumarsinhji wrote several notes and articles in the Society's Journal and in various magazines, he is the author of THE BIRDS OF SAURASHTRA a massive volume which now has become a collector's item. His has to his credit a large number of excellent photographs and his films are valuable documentaries which need to be preserved for all times as valuable records of what was, and what might be if we all bestir ourselves a little more. He was an artist of considerable merit and his pastel of Great Indian Bustards hangs in a room where he used to stay whenever he visited Hingolgadh. His pastels have received awards and a few of them hang in homes of important people. Dharmakumarsinhji also had talent for music and played the sitar for privileged friends. Few know that he was an aviculturist of repute and that in his aviaries at Bhavnagar he had bred the Lesser Bird of Paradise for the first time in captivity and received the Aviculture Society of Britain's prestigeous award for this achievement. At his death, he was the President of the Pheasant Trust UK, and the President of the Taraporewalla Aquarium, Bombay. To add to his many talents, he was a hockey coach of high standard and his death will be mourned by athletes along with naturalists! The Maharashtra Athletics Association will mourn a past President.

Recognising early in life that the birds and animals he loved and hunted were in danger of extinction, he actively involved himself in promoting conservation concepts and was among the pioneers who helped to frame India's wildlife laws, and from the very beginning till his death, he was on the Indian Board For Wildlife, and on the Wildlife Advisory Boards of Gujarat and Rajasthan. In 1950 he had been asked by the Government of India to survey Punjab, Rajasthan, Madhya Pradesh, Gujarat and Maharashtra for suitable wildlife areas. As Vice Chairman of the Indian Board for Wildlife his demise terminates a tenure of 25 years. The Society has lost an old friend and one of its oldest members. Now that he is no longer with us, we shall miss his puckish humour, his outlandish comments like "Girnar is wearing a Bikini" and his loud slow drawl. We all took Dharmakumarsinhji for granted as indeed he took his unique opportunities and it is only the finality of death which has brought home to us what a heavy loss the conservation movement in the country has suffered. But, as long as the Great Indian Bustard roams our wide open spaces, the Lesser Florican bounces up against the monsoon gales over Saurashtra grasslands, skiens of Demoiselle Cranes flight across the pale blue winter skies of Gujarat and the swift Laggar nests on the Hingolgadh balcony, Dharmakumarsinhji's spirit will live on in the hearts of the growing numbers of young naturalists. Yes, while he could have done much more, what ever he has achieved is a great deal and we salute the memory of a sporting Prince and one of India's pioneer conservationists.

SHIVRAJKUMAR KHACHAR
LAVKUMAR KHACHER

R. S. Dharmakumarsinhji's

Publications in the Society's *Journal* between the years 1935 to 1985

The occurrence of the Scaup (*Nyroca m. marila*) in Bhavnagar State, xxxviii, 195; Breeding of the Indian Barn Owl [*Tyto alba javanica* (Gmelin)] in Bhavnagar, xli, 174; The Indian Great Horned Owl [*Bubo bubo bengalensis* (Frankl.)], xli, 174; The Indian Crested Serpent Eagle [*Spilornis cheela cheela* (Lath.)], xli, 177; Jungle and House Crows as destroyers of Game, xlii, 185; Frog eating a Snake, xlii, 200; Injury to a Crocodile (1 *photo*), xlii, 445; Banding of the Lesser Florican (*Sypheotides indica*) in Bhavnagar State *44*: 299; Musk-Shrew (*Suncus caeruleus*) attacking Bull-Frog (*Rana tigrina*) *46*: 180; Breeding of the Blue-cheeked Bee-eater (*Merops superciliosus persicus* Pallas) in Bhavnagar State *46*: 723; Breeding of Palm Swift [*Tachornis batasiensis palmarum* (Gray)] and Coot (*Fulica atra atra* Linn.) in Bhavnagar *46*: 724; The Kentish Plover (*Leucopolius alexandrinus* Linn.) breeding in Kathiawar *46*: 726; Mating and the parental instinct of the Marsh Crocodile (*C. palustris* Lesson) *47*: 174; The Great Crested Grebe (*Podiceps cristatus cristatus* Linn.) in Bhavnagar State *47*: 385; The late stay of migratory birds in Bhavnagar, Kathiawar *47*: 387; Some interesting birds of the Gir and Girnar, Kathiawar *48*: 187; 'Aggressive demonstration by Russell's Viper' *48*: 595; Kentish Plover [*Leucopolis alexandrinus* (Linn.)], breeding on west coast of Saurashtra *48*: 809; The Lesser Florican *Sypheotides indica* (Miller): Its Courtship display, behaviour, and habits. (*With a plate, 2 text-figures and 2 tables*) *49*: 201; The Gir Forest and its Lions. Part II (*With a plate*) *49*: 456 (*With* Wynter-Blyth, M.A.); The Gir Forest and its Lions. Part III *49*: 685 (*With* Wynter-Blyth, M.A.); Occurrence of Hodgson's Pipit (*Anthus roseatus*) in Saurashtra *50*: 175; Blacknecked Grebe (*Podiceps nigricollis* Brehm) in Bhavnagar *50*: 664; Large stone in stomach of Crocodile *50*: 950; The Great Indian Bustard *51*: 740; Movements of Lesser Florican [*Sypheotides indica* (Miller)] *51*: 938; A new Sand Lark from Western India (Saurashtra) *52*: 8 (With Vaurie, C.); Goshawk (*Astur gentilis*) in Bhavnagar (Saurashtra) *52*: 211; Wild Life Preservation in India. Annual report for 1953 on the Western Region *52*: 865; The Whitebellied Sea Eagles of Karwar [*Haliaëtus leucogaster* (Gmelin)] *53*: 569 (With Lavkumar, K. S.); Besra Sparrow-hawk (*Accipiter virgatus*) in Saurashtra *53*: 699; Rednecked Phalarope (*Lobipes lobatus* Linn.) in Bhavnagar, Bombay State *54*: 465 (With Shivrajkumar of Jasdan); Bluetailed Bee-eater *Merops philippinus* Linnaeus in Western Saurashtra *55*: 351; Sandwich Tern [*Thalasseus sandvicensis sandvicensis* (Latham)] *55*: 357; Large Clutch of Nakta eggs *56*: 634; Indian Wild Boar (*Sus scrofa cristatus* Wagner) feeding on *Boerhavia diffusa* Linn. *57*: 654; On the eggs of the Great Indian Bustard [*Choriotis nigriceps* (Vigors)] *57*: 663; Marsh sandpipers (*Tringa stagnatalis*) colliding against telephone wires *57*: 666; Occurrence of the Shelduck [*Tadorna tadorna* (Linn.)] in Bhavnagar, Gujarat State *58*: 275; Communal distraction display in Large Grey Babbler [*Turdoides malcolmi* (Sykes)] *58*: 512; Rufousbellied Hawk-Eagle, *Lophotriorchis k. kienerii* (E. Geoffroy) in North Kanara *58*: 514; The Great Indian Bustard [*Choriotis nigriceps* (Vigors)] at the nest *59*: 173; The Forest Wagtail *Motacilla indica* Gmelin in the Gir Forest, Saurashtra *60*: 261; Occurrence of the House Martin *Delichon urbica* (Linn.) in Saurashtra, Gujarat *65*: 221; Extension of breeding range and other notes on Blackshafted Little Tern (*Sterna albifrons saundersi* Hume) *69*: 420; The Crested Bunting, *Melophus lathami* (Gray) in Bhavnagar (Saurashtra) Gujarat *69*: 655; Occurrence of Redthroated Pipit *Anthus cervinus* (Pallas) in Bhavnagar *72*: 557; Ortolan bunting (*Emberiza hortulana* Linn.) in Kutch, Gujarat *74*: 179; Spotbill Duck (*Anas p. poecilorhyncha*) Forster nesting in a tree *74*: 354; Blackthroated Weaver bird (*Ploceus benghalensis* (Linnaeus) breeding near Bhavnagar (Saurashtra) *74*: 357; The changing wildlife of Kathiawar *75*: 632; Some notes on the Indian Reef Heron *81*: 188; The Black Eagle *Ictinaetus malayensis* Temm. and Lang at Sawai Madhopur (Rajasthan) *82*: 655; Longtailed Minivet record in Saurashtra *82*: 657.

REVIEWS

1. MOUNTAIN WILDLIFE. By Richard Perry. pp. 179 (22.3 x 14.3 cm.). With sixteen black-and-white plates depicting 9 mammals, 9 birds and 1 insect. London, 1981. Croom Helm Ltd. Price £8.95.

When I received a notice that a book on mountain wildlife had been dispatched to me for review by the Society, I anticipated receiving a rather large and well illustrated book on an area which has influenced my life and held my interest now for well over four decades. The slim and certainly not glossy publication which I unwrapped did prove a slight anticlimax. Size and gloss are ofcourse not what makes books valuable for discerning readers, the matter inside is what is really important, however, I did wonder how such a slim book could cover the major mountain systems of the world and their wildlife as was promised by the blurb on the jacket.

On glancing through the photographs I was most disappointed at the very poor selection when I do know that there are in existence some of the most exciting photographs of mountain life whether plant or animal and I had hoped there would be scenic illustrations of the major mountains of the different continents.

I pride myself in being a very rapid reader, but I must confess I found reading through this small book a rather difficult exercise as there was quite apparently no planned sequence of subject handling and just as one settled down to imagining the arid and highly denuded Simean Mountains of Ethiopia, one finds oneself suddenly dropped in dense vegetation and swirling mists of the Ruwenzories and the Virungana volcanoes of Equatorial Africa. The Walia Ibex and the Gorilla are two such different animals that placing them in the same chapter makes for very great discomfort and that too when the chapter is on The Ravaged Mountains of Ethiopia. This sort of jumbling of places and life forms is to be found throughout the book.

Quite obviously, this is one of those books very hastily put together taking facts from various sources one might have seen over a life time. In the chapter on Tahr and Tigers in the Himalayas one is startled to learn of a maneating tigress in Kashmir only to be relieved on reading further that this naughty feline was operating in the hills between the Jumna valley and Chakrata ridge in the Tehri Gharwal Himalayas !

LAVKUMAR KHACHER

2. PLANT HUNTING IN NEPAL. By Roy Lancaster. pp. 194 (24.5 × 15.5 cm), with two maps. 39 line drawings and 20 coloured plates. Kent, 1981. Croom Helm Ltd, Provident House, Price 6.95 £ in UK only.

This book is the travelogue of a scientific expedition to collect plants and seeds in Himalaya. The author and his collegues trekked the little explored parts of eastern Nepal, east of Arun Khola and its tributaries, during three months of the autumn of 1971. They have trekked more than 200 Kms, often crossed the high passes of more than 15000', sometimes they even lost their way and had to undergo many hardships.

The book gives the details of the route through which they trekked and the plants collected, most of which also occur in India, their ecology in wild and comments on their status and ecology in cultivation in the gardens of England. The author also gives other interesting information such as their peculiarities, medicinal values, commercial value, origin of specific names and their taxonomical difference from the nearest relative of many plants. One such interesting information I found is that of *Helwingia himalayaca* (p. 48), in which a pair of fruits are produced apparently from the upper surface of the long pointed leaves. The abnormality is due to fusion of the peduncle with the petiole and midrib. Information about other aspects of natural history, particularly of birds and mammals and also on social life of the people are given at the appropriate places.

They collected 417 batches of seeds and bulbs and have recorded about 370 species of plants from the area visited of which few are very rare plants and some are new records to Nepal.

The last chapter is a well written, essay on plant hunting and a discussion on the need of plant hunting for conservation and scientific studies in future.

On the whole the book is very readable and a good reference book to taxonomists, and phytogeographers and also readable by the amateur naturalists and Himalayan trekkers.

I recommend this book for university libraries and general libraries particularly mountaineering club libraries. The book creates, in a reader enthusiasm and interest in the adventures of plant hunting and often reminds one of the great plant hunters of the past like Lt Col Kingdon-Ward, Frank Smythe and others.

MEENA HARIBAL

MISCELLANEOUS NOTES

1. DUNG WITH A DIFFERENCE

There is a resident population of hanuman langurs (*Presbytis entellus*) in and around the hills of Mahableshwar, Satara District, Maharashtra. Although langurs are said to be largely deciduous forest animals not entering dense evergreen forests (Roonwal and Mohnot 1977) one large and two small troops have been seen in the forests and on the periphery of human habitations at Mahableshwar all the year round.

Langurs are vegetarians, feeding on leaves, fruits berries, buds, flowers, bark, seeds and in rare cases insects. Unlike in the other areas of Urban India where langurs occur and are fed cooked food by humans, in Mahableshwar, the practice does not prevail and the langurs are usually seen raiding gardens, farms and domestic garbage pits from where they are most often ousted by humans. This is probably why the langur community here is wary of humans and their presence. In March 1984, what we saw will perhaps prove that one langur at least, was feeding under extreme tension and in the absence of cheek pouches, had to swallow whatever it had found, fast.

Near the residence Madhukosh, which is on the periphery of the forest, we saw langur dung in one long piece except for a strange gap in the middle. On either side, was excreted matter and in between, a long pink plastic bag, shrivelled in shape to show that it had most certainly passed through the langur's intestine.

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HETA PANDIT

13 Neel Tarang,
210, Veer Savarkar Marg,
Mahim, Bombay-400 016,
July 8, 1985.

DEBI GOENKA

REFERENCE

Roonwal, M. L. & Mohnot, S. M. (1977): Primates of south Asia. Ecology, sociobiology and behaviour. Harvard University Press, Cambridge, Massachusetts & London. i-xviii, 1-421.

2. A POSSIBLE SIGHTING RECORD OF THE MALABAR CIVET (*VIVERRA MEGASPILA* BLYTH) FROM KARNATAKA

During the second week of April 1975, I visited Bhagavathy Valley, Koppa, Forest Division in Karnataka State (lat. 13° 12′ N, long. 75° 12′ E). Located at an approximate elevation of 100 m. in the western ghats, the dense wet evergreen forests of this valley are noted for the dominance of 'Balige' (*Poeciloneuron indicum*) trees in the upper canopy. Though a major highway connecting Kudremukh mines to Mangalore disrupts it now, at the time of my visit the area was very isolated, being connected by a single fair weather logging road.

Travelling in the cabin of a logging truck at about 5.00 p.m., I saw a large civet walking along the road. It seemed bigger than a stripe-necked mongoose (*Herpestes vitticollis*) and was considerably larger than both the small Indian Civet (*Viverricula indica*) and common Palm Civet (*Paradoxurus hermaphroditus*). Standing clear off the ground, it had a greyish indistinctly patterned coat and a black banded tail with a severe injury at mid-length, which I noticed from a distance of about 10 metres. It was not disturbed by the approaching truck, until a worker on the rear deck flung a piece of wood at it ! It snarled before bolting into the bush. I was able to identify it with reasonable certainity as the elusive Malabar Civet (*Viverra megaspila*). Subsequently, I had an opportunity to examine a skin in the BNHS collection.

Malabar Civet, like many other western ghat rain-forest species, has a discontinuous distribution reappearing again only in Southeast Asia. The Indian subspecies is *civettina* Blyth. (Prater 1971). Jerdon (1874) described its range as the westcoast-Western Ghats complex extending from Cape Comorin northwards to 'Honore' (Honnavar, Uttara Kannada dist., Karnataka at about 15°N. lat.) and possibly beyond. He reported its occurrence in the vicinity of villages as well as in densely forested ghat regions. My sighting is within this range.

Due to paucity of recent information, this subspecies is listed as an endangered species by IUCN. A greeting card produced by World Wildlife Fund-India erroneously restricts its distribution to 'Coastal districts of Kerala' and fears that it may be extinct. In my opinion, civets like *V. megaspila* with large distributional range, adaptability to diverse habitat types possibly coupled to versatile foraging strategies, are unlikely candidates for extinction, in the absence of selective hunting pressure. The sighting reported above perhaps supports this view.

CENTRE FOR WILDLIFE STUDIES,
499, KUVEMPUNAGAR,
MYSORE-570 023,
July 25, 1985.

K. ULLAS KARANTH

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3. NOTE ON THE BREEDING OF INDIAN WOLF *CANIS LUPUS PALLIPES* AT THE NATIONAL ZOOLOGICAL PARK, NEW DELHI

Little is known about the reproductive biology and postnatal care of the Indian wolf. This note is based on the data available in the National Zoological Park from November, 1981 to March, 1985 during which period the park could successfully breed the Indian wolf.

The Park obtained two male wolves from Jaipur Zoo on 25th November, 1981. They were released in an open enclosure of approximately 100 metres x 30 metres size with a common corridor interconnecting the cells at the back of the enclosure for locking the animals when necessary. The floor of the enclosure has a thick growth of grass interspersed with shady trees. The two males were released in this enclosure and were fed on 3kg of buffalo meat per day per animal except on Fridays. They were subsequently joined by a female received from the Indore Zoo on 28.10.1982 which eventually died on 16.12.1982 On 19.4.1983 one of the two males was returned to the Jaipur Zoo and a female was obtained on breeding loan on 24.3.1984 from the Mysore Zoo. They were seen to mate for three days on 10.12.1984, 11.12.1984 and 12.12.1984 and each mating lasted for about 14 minutes, 12 minutes and 10 minutes respectively. The female during the advance stages of pregnancy completely disappeared into a burrow dug up earlier by her. This burrow which had a single opening to begin with was supplemented with two more openings leading into a central chamber. The male was removed earlier from the enclosure and kept in a cell separately. The female did not take meat given to her on 13.2.1985 and 14.2.1985, therefore it is presumed that she littered on 13.12.1985 after a gestation period of 63 days. The whelps were first sighted on 9.3.1985 when 4 cubs were seen. On 10.3.1985 5 cubs were seen. They still spent most of their time in the burrow and came out only for a short period in the morning and evening, the diet of the female consists of 3 kg. of buffalo calf meat, $\frac{1}{2}$ litre milk and one rabbit once a week.

Our data agrees with Prater's observation of wolf pups being produced in the spring or early summer in Himalayas unlike the main breeding season of wolves in India at the end of the monsoon and the cubs being born in December. The litter size of 5 cubs is within the usual reported range of three to nine in a litter.

National Zoological Park,
Mathura Road,
New Delhi 110 003,
March 15, 1985.

J. H. DESAI
MAMMEN KOSHY
T. NAINAN

4. OBSERVATIONS ON THE RED FOX (*VULPES VULPES ARABICA*) IN THE AL AIN AREA, UNITED ARAB EMIRATES

Introduction

There is much Red Fox activity throughout the United Arab Emirates. They inhabit rocky mountainous regions or well watered urban and suburban areas. They appear, however, to be absent from the open sand dunes. There have been no previous studies of the parasites of this species in this country. Since December 1979 Red Foxes have been snared and shot in the zoo as a disease control policy. They have also been responsible for a number of deaths of new-born mammals and waterfowl in the zoological collection. Fourteen of these foxes were autopsied, and the gastro-intestinal contents of thirteen were examined to establish as far as possible the diet, and estimate the potential danger to the zoo animals of incoming parasites carried by the foxes. The weights of some animals were noted, in order to compare with captive Red Foxes in the zoological collection.

METHODS

All foxes were caught using wire snares, and then shot dead. Autopsies were performed within twelve hours of death, often within one hour. Endoparasites visible to the naked eye were removed from the digestive tract, washed in distilled water, and preserved in methanol for identification. Contents of the stomachs were separated and identified as far as possible. The uteri of both vixens were opened for examination.

RESULTS

The gastro-intestinal contents of thirteen foxes were examined. Massive infestation with cestodes was found in eleven of the thirteen, present in the small intestine. This was identified as *Joyeuxiella echinorhyncoides* Sonsino 1889. In addition, Echinococcus-like cestodes were found in the caecum of one fox.

Nematodes were present in the caecum and colon of seven of the thirteen foxes. An unidentified *Trichuris* spp. was found in all seven, and *Oxynema crassispiculum* Sonsino 1889 was noted in two of these seven animals. Only two foxes out of the thirteen carried no visible endoparasites. One animal was found to have Ixodid ticks attached to the ears.

Of the thirteen animals in which the stomach contents were examined, eight had empty stomachs. Those with full stomachs contained hair, feather shafts, pigeon remains, maggot shells, several pieces of fat, a strip of goat skin, fish bones, and a half digested date complete with stone.

Both females were pregnant. One, killed on 9.1.1980, weighed 3.18 kgs and carried two embryos in the right cornu and one in the left. The second female, killed on 26.1.1980, weighed 4.3 kgs and carried two foetuses in the left cornu and one in the right. Pregnancy was more advanced in the second animal.

DISCUSSION

The endoparasites of Red Foxes in Britain have been mentioned by Richards (1977). He recorded flukes, hookworms, and whipworms. Those found in this study indicate that *Trichuris* spp. may be carried by over half the foxes of this region, while *Oxynema crassispiculum* is harboured by a very few animals. *Joyeuxiella echinorhyncoides* appears to enjoy an endemic distribution among the foxes of this area.

The occurrence of the Echinococcus-like organisms is interesting, as the local Bedouin population may sometimes be affected with hydatidosis (M. Blake, pers. comm.). Camels may carry large hydatid cysts, and camel meat is often eaten. Dead camels may be left in the desert, rather than being burned or buried, where wild foxes may reach them. The Red Fox, therefore, may possibly play a role in the life-cycle of this parasite locally.

Ixodid ticks have been found on British foxes by Harris (1978), who recorded *Ixodes hexagonus* and *Ixodes canisuga.* Ticks do not appear to be a major problems for Red Foxes in this area, with only one fox infested. It is not known whether these ticks are involved in transferring blood parasites.

The variety of stomach contents found gives an idea of the diversity of the diet of this species. Richards (1977) made an extensive study of the diet of this animal in Devon, Britain, and listed mammals, birds, reptiles, fruit and insects as the chief items of consumption, in addition to carrion. Burrows (1968), quoted by Richards, states the Red

Fox may kill hedgehogs. Johnson (1980) has even recorded Red Fox catching fish, in Scotland. Harrison (1968) indicates foxes in Lebanon feed on figs, grapes, other fruit, insects, and small vertebrates. The findings here confirm the Red Fox is as much a scavenger as a predator, the maggot shells and fish bones almost certainly coming from a local garbage dump frequented by dogs, cats, and foxes (personal observation). Fruit may be consumed when available. The data here is not sufficient to deduce whether certain items of food are consumed preferentially on a seasonal basis. Live prey in this area includes birds (mainly pigeons and doves), rats, desert rodents, reptiles (both lizards and snakes), and insects. Captive Fennec foxes in the zoological collection readily eat locusts, which are caught locally from the desert.

The breeding season for this species has been stated by Harrison (1968) to occur during December and January, with parturition in March or April. The results here confirm these observations. Another local canid also breeding in winter is the Arabian Wolf (*Canis lupus arabs*).

The weights of those Red Foxes listed in Table 1 appear to be the first such measurements of *Vulpes vulpes arabica* using freshly killed animals. The degree of parasitism did not affect the body weight, there being heavily infested animals weighing both more and less than lightly infested animals. The heaviest fox was the pregnant vixen shot in an advanced state of pregnancy, and the lightest was a juvenile male, weighing 2.35 kgs. The average weight for a male was 3.40 kgs, with a range of 2.35 to 3.86 kgs.

TABLE 1

Sex	Weight (kgs).
M	3.6
M	3.86
M	3.18
F	3.18
M	3.72
F	4.3
M	3.54
M	3.425
M	3.6
M	2.35

ACKNOWLEDGEMENTS

I would like to thank the staff of the British Museum (Natural History section) for their help in identifying parasites.

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April 6, 1985.

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HARRISON, D. (1968): The Mammals of Arabia: Volume 2. Carnivora, Hyracoidea, Artiodactyla.

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London, Benn, p. 213.

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Richards, D. F. (1977): Observations on the diet of the Red Fox (*Vulpes vulpes*) in South Devon. *J. Zool. Lond. 183*: 495-504.

5. POSSIBLE PLAY BETWEEN THE INDIAN GIANT SQUIRREL (*RATUFA INDICA INDICA*) AND THE COMMON LANGUR (*PRESBYTIS ENTELLUS*)

A behavioural sequence that may be interpreted as play was observed between a juvenile (one-year old) female *Ratufa indica indica* and a male Common Langur *Presbytis entellus.* This was recorded at the Yellapur Reserve Forest, North Kanara District, Karnataka.

At 2.16 p.m. on the 30th of March 1985, the female squirrel rested 2 feet from the male langur who was sitting erect apparently also resting in an *Olea dioica* tree. At 2.17 p.m. the squirrel moved about a foot further away and rested horizontally on the same branch. At 2.18 p.m., she approached the langur and then moved away to feed on the Olea fruit nearby. At 2.23 p.m. the langur approached the female and cuffed her gently on the head. She slid beneath the branch; then nearing the langur appeared to initiate play by jerking her body. They indulged in a small chase in adjacent branches. The squirrel moved away and continued feeding while the langur adopted the same resting posture as before. The whole sequence lasted for a minute. At 2.27 p.m., the langur left the tree to join other members of the troop. There did not appear to be any aggression during the sequence. Neither of the participants vocalised during this interaction.

Olea dioica (Oleaceac) is one of the commonest middle storied tree in this forest and several individuals were fruiting profusely in the area at that time. Therefore it is unlikely that the sequence originated due to competition for the fruit source. It seems possible that interspecific play did occur in this case.

T-4/24-1 Magod Colony,
Taluka Yellapur,
Dist. North Kanara,
Karnataka-581 372,
April 15, 1985.

RENEE BORGES

6. AN INSTANCE OF PREDATION OF GREY QUAIL BY THE INDIAN GERBILLE

The Indian Gerbille *Tatera indica* (Hardwicke) is found throughout India and mostly inhabit dry and sandy soils. Its food consists mainly of grains, roots, leaves and grass. According to Prater (1971) it also eats insects and their grubs, the eggs and nestlings of ground birds and quite probably kills and eats smaller rodents.

On 1 February, 1985, wonder traps were closed at about 1700 hr after three days of pre-baiting with wheat grains for collecting rodents on a waste land of the Punjab Agricultural University area, Ludhiana (30° 56′N, 75° 52′E). This waste land (*c.* an acre) is present in the middle of crop fields of the University and contains quite sandy soil on which mainly Wild Thatching Grass, *Saccharum spontaneum* grows. The waste land has an established colony of the Indian Gerbilles. In one of the traps, on 2 February 1985 at about 1130 hr, one dead Grey Quail *Coturnix coturnix* was found. It was an adult male with fully ossified skull and testes fully developed. It had been gnawed at by a pair of adult Indian Gerbilles (male body weight 160 g, female body weight 150 g) caught in the same trap. Eaten parts of the body of quail were: hind legs (tarsus and toes), neck, a small portion of skull where the first vertebra attaches, upper parts of breast and a small portion of keel. Remaining body parts of the quail weighed 33.5 g whereas average body weight of an adult is around 47 g (average of five Grey Quails captured from the same waste land).

This is a case of incidental predation under confined conditions but support the observations recorded by Prater (1971). The occurrence of this phenomenon in nature is yet to be established but it may be expected that the Indian Gerbilles can kill and eat small ground birds if they are sick or for some reason unable to protect themselves at night when the former remains active in search of food.

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REFERENCE

PRATER, S. H. (1971): The Book of Indian Animals. Bombay Natural History Society, Bombay.

7. A COMMON SANDGROUSE'S REACTION TO A SHORT-TOED EAGLE

On 30 June 1983, near Nanaj, Solapur, we were searching for the Great Indian Bustard, when we saw a big whitish bird on the ground about 700 metres away, which we first thought to be a bustard. However, looking through a telescope revealed that it was a Short-toed Eagle (*Circaetus gallicus*) facing us and eating something. When we went nearer, the eagle flew carrying a part of the prey. However, we found one leg and a wing of Common Sandgrouse (*Pterocles exustus*). Feathers including down feathers were scattered, indicating that it was a young sandgrouse. While collecting the remains of the unfortunate victim, we saw an adult sandgrouse sitting immobile about a metre from the place where the eagle was seen eating its prey. The adult sandgrouse was so terrified that it did not fly away while we were collecting feathers and taking notes. However, it flew away when one of us touched it. We think it was the parent of the juvenile which froze when the eagle caught the young one. After finishing its meal, the eagle could have easily caught the adult sandgrouse, if we had not gone there or perhaps it would have missed the immobile adult.

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ASAD R. RAHMANI
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8. AN ABNORMAL BEHAVIOUR BY A BREEDING PAIR OF BLUE ROCK PIGEON (*COLUMBA LIVIA* GMELIN)

While studying the breeding behaviour of Blue Rock pigeon (*Columba livia* Gmelin) at Sector 18, Chandigarh (India), a strange behaviour was exhibited by a breeding pair which is worth recording.

A pair of *Columba livia* started constructing a nest on a ledge of a Verandah on 27-1-82 in a house. The nest was completed by the breeding pair on 5-2-82. Against the usual clutch of two eggs, only one was laid on 8-2-82. On 25th February, 1982, the egg hatched between 10 a.m. to 2 p.m. Brooding (of hatchling) continued during the day and night of 25-2-82. On 26th February, 1982, the one-day old chick, was seen to be thrown on to the ground along with some nesting material at 1.30 p.m. by one of the breeding partners. The hatchling along with the some fallen nesting material was placed back on its original nesting site at 2.30 p.m. The bird returned to the nest at 3.15 p.m. and again started pushing off the nest along with the chick but before it could fall down, the bird was chased off and the chick placed at a safer position in the nest. The bird returned again at 4.35 p.m. but did not bother about the chick and instead started picking up the nesting material from the abandoned nest to construct a new nest at about $\frac{1}{2}$ meter away from the previous nest. The fallen sticks were also picked up and used in the new nest. The bird left the nest at 6.25 p.m. for roosting, leaving the chick unattended. On 27-2-82, the pair returned to the nest at 8.30 a.m., and indulged in courtship and then selected another nesting site about 3 metres away from the deserted nest but on the same ledge. The chick died on 28-2-82, when it was picked up and preserved in 90% alcohol. The new nest construction was still underway on 6-3-82 but at a slow pace when the junior author left the place due to unavoidable reasons.

The junior author is grateful to Mrs. & Mr. Naresh Bhalla, 18/C, House No. 1162, Chandigarh for allowing us to carry out this study at their residence.

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9. ON THE OCCURRENCE OF THE CEYLON FROGMOUTH (*BATRACHOSTOMUS MONILIGER*) IN NORTH KANARA, KARNATAKA

A female Ceylon Frogmouth (*Batrachostomus moniliger*) was brought to me by a local villager on the afternoon of the 12th of February, 1985. He had caught it in a forest patch near his home at Magod, Taluka Yellapur, District North Kanara, Karnataka, a short while prior to giving it to me. He had apparently flushed a pair of birds near the base of a *Maba ebescens* tree and was able to catch only one. The bird was unhurt and allowed itself to be handled easily.

Measurements of its bill (21 mm.), wing (122 mm.) and tail (102 mm.) are within the recorded range (Ali and Ripley 1970).

The bird was released shortly at the same place where it had been found. It flew up into dense foliage within less than a minute, remaining motionless and perfectly concealed for a long while. Search of the surrounding area did not reveal a nest. Assuming that the second bird was also a frogmouth and possibly a male, they may have been breeding at that time. Repeated visits to the same site since then have not been fruitful.

This find is considered noteworthy firstly because the frogmouth is regarded to have rare status and secondly because the forest patch in which it was found is a very small, extremely disturbed area adjacent to a jeepable road and a village clearing. Ali and Ripley (1970) report its occurrence in evergreen forest and secondary forest with cane brakes. The area in which it was found is adjacent to though not continuous with such forest. The status of the bird needs to be re-investigated and the type of habitat it might inhabit be re-evaluated.

T-4/24-1 Magod Colony,
Taluka Yellapur,
Dist. North Kanara,
Karnataka 581 372,
April 15, 1985.

RENEE BORGES

Reference

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10. BREEDING BIOLOGY OF BAYBACKED SHRIKE (*LANIUS VITTATUS*) AT NATIONAL ZOOLOGICAL PARK, NEW DELHI

In this study attempts have been made to describe the breeding season, incubation period, growth and development and reproductive success of Baybacked Shrike (*Lanius vittatus*) at the National Zoological Park during 1982-83.

The Park is spread over an area of 214 acres, with abundant vegetation including trees, shrubs & herbs which form excellent nesting sites for the free living birds. For the study of nidification and behaviour, nesting birds were observed normally and through a 7 x 50 prismatic field binoculars. The observations were made during the early morning, forenoon, midday and late afternoon on successive days.

The Shrikes breed from April to July all over the Park. The nests were built in the forks and crotches of branches of different trees at varying heights.

At the National Zoological Park, the Shrike nests were in shape of compact cups made of dry thin grass, wool, and feathers. The nests were built by both partners. A pair took 6 to 8 days to complete a nest at the Park. The nests were found at heights varying from 1.3 metres to 5 metres. During this study at the Park, 3 to 4 eggs were found in a clutch. The eggs were laid one after the other after a day's interval. The eggs were oval, shell dark white/pink white and in some cases egg shells were marked with purplish brown spots.

Ali & Ripley (1968) state whether both the parents incubate the eggs is not known and that the incubation period is undetermined. According to observation at the National Zoological Park, both the male and female were found to incubate the eggs, however the female incubated most of the time. Male was observed to stand guard on the near by tree or branch to protect the nest from crows, hoopoes, mynas and sparrows. The male also brought insects which included moth, butterfly and grasshoppers to feed the incubating female.

The eggs were marked with ink on the day of laying. The date of hatching was also recorded. The difference between the two dates was taken as incubation period. The incubation period as observed in ten cases at National Zoological Park varied from 14 to 15 days with an average of 14.6 days.

Feeding of young was done by both the parents. Food gathering was mainly done by the male who passed it over to female which in turn fed the young. As many as twenty one trips were recorded on a single day from 11 a.m. to 3.10 p.m. by a pair raising a brood of three chicks.

Growth & Development

Age in Days	Remarks
0–5	The weight at the time of hatching varied from 3 to 4.5 gm. The average weight calculated for 10 chicks was 3.5 gm. The chick was tiny, naked, dark pink in colour with black eye ball prominent and eyes closed. The newly hatched chick was able to raise its neck but was unable to stand and called frequently.
5–10	Gape yellow, primaries and secondaries appeared on 3rd day. Head with black primordial feathers. Dorsal side slaty black with primordial feathers. Ventral side naked, colour of chick changed to dark pink. At five days the chick weighed 13 gm. Eyes opened at 5-6 days of age.
10–15	Dorsal side covered with dark brown vexillum. Ventral side with white feathers except the midline. Tail with light brown feathers. Perching seen at the age of 13-14 days. Parents fed and protected the chick till this age, chick left the nest at the age of 14-15 days.

TABLE 1

REPRODUCTIVE SUCCESS OF BAYBACKED SHRIKE AT NATIONAL ZOOLOGICAL PARK

Year	No. of eggs laid in 4 nests	No. of hatched young that fledged in 4 nests	Reproductive success in %	No. fledged young per pair
1982	12	4	33.33	1.00
1983	14	6	42.85	1.50
	26	10	39.15	1.2

During two breeding season a total of 8 nests were marked for studying the reproductive success. A total of 26 eggs were laid in these eight nests, out of which 18 (69.2%) hatched. Out of 18 young 8 died due to predation & accidental falls from the nest. The reproductive success was the 39.15% or 1.2 chicks per nest during the study (Table 1).

NATIONAL ZOOLOGICAL PARK,
NEW DELHI 110 003,
January 16, 1985.

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REFERENCE

ALI, S. & RIPLEY, S. D. (1968): The Handbook of the birds of India and Pakistan. Vol. 5. pp. 85-86.

11. A RE-ASSIGNMENT OF TWO SMALL BABBLERS AT PRESENT IN THE GENUS *YUHINA*

(*With a text-figure*)

Typical species of the genus *Yuhina* have long bills with basal ends of even thickness, straight lower mandibles, and tapering, down-curving upper mandibles. Crown feathers are elongated and tapering. The tail is moderately long, square-ended and uniformly coloured. Two species previously constituting the genus *Ixulus*, now assigned to *Yuhina*, have shorter, stouter bills of similar type and short blunt crests, but are otherwise similar. They may show the more generalised form of characters of the latter genus. Two species appear to be wrongly assigned to *Yuhina*. *Y. zantholeuca* has green plumage, a shorter crest, and a deep-based tapering bill typical of the genus *Stachyris*, to which it is proposed to re-assign it. *Y. castaniceps* has a bill in which upper and lower mandible both curve to a blunt tip, a very brief crest, and a strongly graduated, white-tipped tail. It does not appear obviously related to this or other genera, and it is proposed to re-assign it to its original monotypic genus as *Staphida castaniceps*.

INTRODUCTION

During a recent study of the Babblers, Timaliidae, an examination of the small babblers of the genus *Yuhina* brought to my attention some apparent errors in the taxonomic grouping of these birds. In the past, and even in current taxonomy the family contains an unusually large number of small or monotypic genera, indicating a high degree of morphological diversity and specialisation, and possibly an origin or radiation earlier than those of similar but more uniform taxa. Speciation has been particularly complex in southeast Asia and it has produced a number of basically similar small species, some of which have been brought into the genus *Yuhina* Hodgson 1836.

In part this follows a claim during the last few decades that too many and too small bird taxa were recognised, particularly at generic level. This was followed by a general policy of "lumping" to produce larger units. A distinct character of such lumping was an apparent determination to eliminate very small or monotypic genera, to a point where it sometimes became irrational.

The point at which taxa are joined to form larger groupings within a classification is a subjective choice of the classifier; but if a classification is to be useful and meaningful there is a need for consistency in criteria and arrangement at each level in the hierarchy. The application of this at the generic level will always lead to species being grouped into genera of varying size on the basis of apparent evolutionary origin from a single ancestral form.

If this arrangement is applied consistently it is likely that in many instances one or more isolated species will be found which do not fit into other generic groupings and which possess a combination of characters which set them apart from the others. These may be forms that have not produced an evolutionary adaptive radiation, or that had other closely related forms which have become extinct, and are therefore the hierarchal equivalents of groups of species. Their present status within a classification is most properly and adequately expressed by treating them as monotypic genera. However, the tendency has been to search for a genus already containing a number of species, to which they have some resemblance, and to merge them into that genus.

In *Yuhina* there appear to be two subgenera, previously both genera, that have close affinities with each other, but in addition two species have been included the affinities of which appear to lie elsewhere.

THE YUHINAS

There are five typical Yuhinas — the Stripethroated Yuhina *Y. gularis* Hodgson 1836, the Whitecollared *Y. diademata* Verreaux 1869, the Slatyheaded *Y. occipitalis* Hodgson 1836, the Taiwan *Y. brunneiceps* Ogilvie-Grant 1906 and the Blackchinned *Y. nigrimentum* Blyth 1845. They are small birds, with a bill of uniform thickness towards the base, but long and thin with a straight lower mandible and the upper mandible tapering and downcurved towards the tip, and the tip often very slightly decurved (Fig. 1 C). The feathers of the crown are elongated and tapering and form a pointed crest, and the tail is moderately long and square-ended. Although colours of head and crest vary, the rest of the plumage, including the tail, is relatively uniform in colour and in shades of browns and greys.

There was a smaller genus of similar species, *Ixulus* Hodgson 1844. Several of what were regarded as separate species within it have been combined as a single species, the Yellownaped Ixulus *I. flavicollis* (Hodgson, 1836). The bill is shorter and more blunt than those of typical yuhinas, but shares the same character of a straight lower mandible and an upper mandible tapering and curving towards the tip. The crown feathers are elongated but still broadly rounded at the tip and the crest is shorter and broader. A second species, the Whitenaped Ixulus *I. bakeri* (Rothschild, 1926) (previously *Siva occipitalis* Blyth 1845) has a still stouter but similar bill (fig. 1 d), and similar crest. Both species show some pale rachial streaking on parts of the plumage, notably face and mantle, but in general character are otherwise similar to *Yuhina* species. *Ixulus* has been combined with *Yuhina* in recent taxonomy; the bill and crest characters being regarded as more generalised stages of those found in species of the latter genus. Taxonomically the seven species appear to form a reasonable unit.

THE RE-ALLOCATED SPECIES

The Whitebellied Yuhina or Whitebellied Erpornis *Y. zantholeuca*

The species *Erpornis zantholeuca* Hodgson 1844 constituted a monotypic genus which was, in the past, loosely associated with *Yuhina* and *Ixulus* and in the re-classification of these species has been combined with them as *Y. zantholeuca.* It is uniform olive-green or yellowish-green above and on the head, and pale greyish-white below. The crown feathers are moderately but not markedly elongated and tend to have a darker streak along the rachis. In these respects it differs from *Yuhina* species. It resembles them in general structure, but the bill is different (fig. 1 a).

The bill is dorsoventrally deep at its base, and although there is a very slight curvature of the culmen it tapers fairly evenly to a point, the lower mandible tapering as well. At its tip the upper mandible is slightly decurved, just overlapping that of the lower mandible, but the curvature appears greater, due to the presence of small tomial notches on either side of the upper mandible just proximal to the tip.

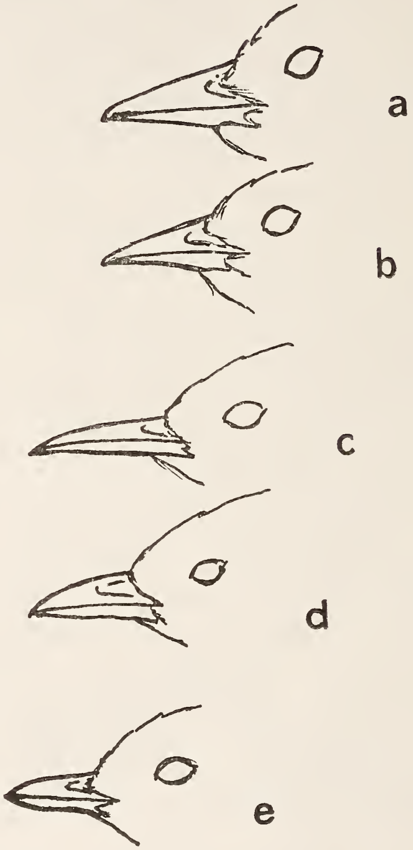

Fig. 1. Bills of — a, *Yuhina* (*Erpornis*) *zantholeuca*; b, *Stachyris chrysaea*; c, *Yuhina occipitalis*; d, *Yuhina* (*Ixulus*) *bakeri*; e, *Yuhina* (*Staphida*) *castaniceps.* approx. × 1½.

This deep-based tapering bill sets the species apart from those of the enlarged *Yuhina* genus; but the character is typical of another genus of small babblers — *Stachyris* Hodgson 1844. It is difficult to see how this was overlooked in earlier taxonomic work, apart from the accident of a diversity of basically similar species and the lack of linear proximity in past arrangements. *Stachyris* is a large genus with twenty-five species, and shows variation in colour and pattern among them. The differences in plumage which set *zantholeuca* apart from *Yuhina* species can be matched in *Stachyris* by those shown by the Goldenheaded Babbler *S. chrysaea.* This is a much smaller species than *zantholeuca,* but with a similar bill. It has a similar geographical range from the Himalayas to Sumatra. It too is olive-green in colour with dark rachial streaking on slightly elongated crown feathers; but the paler underside and the head are suffused with yellow.

On the basis of its morphology I propose to transfer the species originally *Erpornis zantholeuca* Hodgson 1844 from the genus *Yuhina* to *Stachyris,* as the Whitebellied Babbler *S. zantholeuca.*

The Chestnuteared Babbler *Y. castaniceps*

This species, also known as the Whitebrowed Yuhina and Chestnutheaded Staphidia, was originally subdivided into five species and constituted the genus *Staphida* Gould 1871 (also erroneously spelt *Staphidea* and *Staphidia,* see Deignan in Peters (1964). It was later included in *Yuhina,* although Baker (1922) had pointed out that this was an error.

The species is brown above and white below. The head colour varies in the subspecies from all chestnut, to grey with chestnut ear-coverts. and whitish rachial streaks on head and back, and grey crown with chestnut ear-coverts and nape, and short whitish streaks on nape and back. The crown feathers are rounded and slightly elongated to form a small blunt crest on most forms. The bill is small and blunt with a slight upward curvature towards the tip on the lower mandible, and a similar downward curvature on the upper mandible. The bill-shape is not like that of *Yuhina* species, and is perhaps more like that of the Titbabblers *Alcippe* species. The tail is strongly graduated and except on the central pair the feathers have large white tips, increasing in size towards the outer pairs.

The pale streaks on feathers of back and face may have invited comparison with *Yuhina* (*Ixulus*) *bakeri,* which has the bluntest bill among the Yuhinas, and the short crest may have seemed somewhat similar to the shorter crests of what were originally *Ixulus* species. In fact *castaniceps* was originally assigned to the latter genus. However, the different bill-shape, the difference in tail shape and pattern which does not immediately link it with any particular taxon, and the fact that the short crest and some streaking of plumage also occur in other genera of small babblers, justifies the separation of this species from the present genus *Yuhina* which is otherwise consistent in character.

I suggest that it should be retained as the Chestnuteared Babbler *Staphida castaniceps,* in a monotypic genus.

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12. THE RUFOUSTAILED FLYCATCHER, *MUSCICAPA RUFICAUDA* IN BHARATPUR, RAJASTHAN

At about 9.30 a.m. on the 28 September 1984, I saw a solitary Rufoustailed flycatcher flying about amongst the foliage of a *Ficus religiosa* tree in the heart of the Keoladeo National Park in Bharatpur. The bird was smaller than a sparrow and superficially quite similar to the Brown flycatcher *Muscicapa latirostris.* It was plain dull brown above with ashy underparts. The eyes were large with a faint white eyering and when I looked at it intently with my 10 x 35 binoculars, I could make out the blackish legs and the flesh coloured lower mandible. Identification was rendered positive due to the presence of a rufous rump and tail which were conspicuous especially in flight.

The bird was observed for about 20 minutes as it restlessly flitted about the foliage in the upper canopy of the tall tree. It never launched a typical flycatcher-like sally but instead foraged by moving about only within the canopy and boughs.

The flycatcher was obviously on its south bound, autumn passage as the INDIAN HANDBOOK (compact edition, p. 490) says that it breeds in the western Himalayas and winters in the evergreen tracts of south western India. This happens to be the first record of the occurrence of this species at Bharatpur. The "Checklist of the birds of Delhi, Agra and Bharatpur" (Abdulali & Panday 1978) indicates that the species has been dubiously recorded in the Delhi area.

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13. ON THE IDENTITY OF THE EASTERNMOST RACE OF *PRINIA CRINIGER* (HODGSON) IN INDIAN LIMITS

In 1924 Stuart Baker described *Suya* (now *Prinia*) *criniger assamica* from Shillong, Assam, and said the distribution was south and east of the Brahmaputra, and in the Chin Hills. It was said to be much darker brown than *criniger* Hodgson, the nominate form from Nepal and *striatula* (Hume, Karachi) from the west, almost as dark as *yunnanensis* and to have the head boldly streaked, even in the breeding plumage.

Deignan, 1942 accepted all three races from India, without comment, and followed them up with *catharia* (Reichenow, Tatsieng-lu-ting in Setschuan), *parumstriata* (David and Oustalet, Fukhien) and other races from further east and south.

Ripley, 1961, in the first edition of SYNOPSIS, referred to Assam birds as *yunnanensis* (Harington). Then in 1973 (with Sálim Ali) changed over to *catharia* (which was said to include *yunnanensis, assamica* and Koelz's *nebulosa,* from Cherrapunji, Khasi Hills), without giving any reason or explanation. This is repeated in the second edition of SYNOPSIS (1982).

In the course of cataloguing the Bombay Collection, the large series from Simla accepted as of the nominate form, showed some differences in the tail and other measurements and also indicated that in nominate *criniger*, at least, the head was *not* streaked in the breeding season. This called for comparison with specimens of other races and in the absence of material in Bombay, the British Museum (Natural History) lent us at our request specimens of *assamica* (12), *catharia* (7) and later *yunnanensis* (8). The American Museum of Natural History also assisted with another five from Wanhien, Central Szechuan, which according to the Times Atlas, is approximately 140 km. N.E. of Kangting (Tatsienlu) presumably the type locality of *catharia.*

Having got together some 80 specimens of several races, we thought it would be worthwhile recording some of our findings, relating mostly to the seasonal changes of plumage and tail measurements of the races occurring in India, which need to be appreciated for further work.

(a) Adult males of all the races in India have in the breeding season a black bill contra-horny/yellowish in winter, and as is visible at all seasons in the females and young males.

(b) The males in all races are larger than females.

(c) Where both winter and summer specimens are available from the same place, males have their tails longer in summer though at the same time the females have them shorter than in winter.

nominate *criniger* tails

♂♂ summer (15) 81-108 av. 94 winter (3) 80, 83 & 87

♀♀ summer (5) 56- 73 av. 65 winter (2) 76, 83

assamica tails

♂♂ summer (2) 103, 113 ♂ winter (1) 98

♀♀ summer (5) 54-80 av. 65 ♀ winter (1) 85

The first impression that the female has a shorter tail to enable her to sit inside the covered nest is countered by Stuart Baker's very definite statement in NIDIFICATION (2, p. 470) that the male also incubates a statement repeated in INDIAN HANDBOOK.

(d) In winter, both sexes of *criniger, assamica, yunnanensis* and *catharia* have streaks on their heads which disappear in the breeding plumage leaving them almost unmarked brown or blackish in *assamica* and *yunnanensis,* where the streak marks have to be looked for.

(e) If the relative wing measurement of the two sexes are considered, these birds fall into two distinct groups:

  (i) In *striatula, criniger, assamica* and *yunnanensis* the males have their wings 55-60 mm or more averaging about 14% larger than in the females which measure around 50 mm., and

  (ii) In *cooki, catharia* and *parumstriata* (?) the males have their wings around 50 mm. and the females are about the same size or at the most 3 mm. (6%) smaller.

Accepting this difference in wing-size between the sexes as atleast of subspecific importance, the *catharia* group is excluded from Indian limits and *assamica* must be either a synonym of *yunnanensis* or distinct. Considering the fact that Stuart Baker when describing *assamica* referred to their being almost as dark as *yunnanensis*, we were inclined to accept this difference. There is no doubt however that he was confused to some extent, for the picture of the bird by the nest (Fauna 2 plate 7 facing page 520) shows a streaked head, i.e. in winter and not in summer plumage. Deignan (1942, p. 10) also refers to the streaking of feathers of the front, crown and nape in summer, though the streaking is then really lost. The same statement is repeated in INDIAN HANDBOOK (8, p. 72).

Harington while describing *yunnanensis* said that the winter plumage was unknown, but refers to the birds collected by Col. Rippon in March-April. Two of these dated 14 & 17 March 1902 (B.M. Nos. 1903-8-8-483 and 484) have streaked heads and are no doubt in winter plumage.

Seven skins of *criniger* received from B. M. are collected from different places in Szechuan, the type locality of *catharia*. Four of these are marked *parumstriata*, the type locality of which is Fukhian, about 3000 km. south east of Szechuan on the eastern coast. As we do not have any topotypical *parumstriata* to compare with, all are left as *catharia*, together with the 5 from A.M.N.H.

With the literature and the specimens available, it is not possible to comment upon the identity or distribution of the birds from China, (other than from Yunnan) except that they show a lesser difference between the sexes in wing size, and prominent rufous edges to the primaries and secondaries which in some cases makes a rufous patch on the wings. This character is lacking in all the birds from India except 4 from Bhutan. Both *catharia* (8) and *parumstriata* (4) have their bills visibly smaller than in *criniger* and *assamica*.

In view of the several uncertainties referred above, we think it best to accept *assamica* until such time as the characters of wing size differences between the sexes, seasonal changes in tail size, and streaking on head are worked out with more material obtained in summer and winter. This decision does not burden the nomenclature, but only keeps the problem open for further study.

We are indebted to British Museum (Natural History) at Tring and the American Museum of Natural History, New York for the loan of the specimens from India and China.

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14. REMOVAL OF THE NORTHERN LEAF WARBLER, *PHYLLOSCOPUS TROCHILUS ACREDULA* (LINNAEUS) FROM THE INDIAN AVIFAUNA

The inclusion of the Northern Leaf Warbler, *Phylloscopus trochilus acredula* (Linnaeus) in the Indian avifauna is based on a single ♂ obtained by Salim Ali at Dediapada, Rajpipla, Gujerat on 29 March 1946 (Collector's No. GS 1137) and identified by Meinertzhagen and confirmed by Dr. James Harrison. The label is later marked *P. tytleri* and initialled DR (Dillon Ripley) but repeated as *P. trochilus acredula* (Linnaeus) in both INDIAN HANDBOOK (1973, 8: 134) and SYNOPSIS (1982). The 6th primary is emarginate and if the key in INDIAN HANDBOOK is accepted, this identification is erroneous and the bird has to be removed from the Indian list.

As we had just commenced with this notoriously difficult group, we thought it best to refer it to the British Museum (N.H.) whence Mr. Peter Colston confirms that the specimen B.N.H.S. No. 6112 (other details as above) is neither *trochilus* nor *tytleri* but, as we had suspected earlier, *P. trochiloides viridanus.* While the first mistake could have started with a slip in the writing or reading of *trochiloides*, the later identification as *tytleri* is inexplicable.

In any case it would appear fairly certain that the Leaf Warbler *P. trochilus acredula* No. 1572 in INDIAN HANDBOOK and SYNOPSIS is wrongly identified and must be removed from the Indian list.

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15. PLUCKING OF MALE FLOWERS OF *MOMORDICA DIOICA* BY THE BLACKTHROATED WEAVER BIRD *PLOCEUS BENGHALENSIS*

Areas where *Lantana* and *Lagerstroemia* are not abundant, flowers of *Cucumis melo* var. *momordica* and *Momordica dioica* are inserted for decoration in half-built nests by male *Ploceus benghalensis.* It is very interesting and curious that only *male* flowers of these plant species are used.

I studied the insertion of male flowers of *M. dioica* in Eastern Rajasthan, at Tatarpur Mixed Plantation "C", and found many interesting things connected with the problem.

Nesting of the Blackthroated Weaver Bird and flowering of *M. dioica* are coincident in E. Rajasthan. I studied a large number of half-built nests and always found only ♂ flowers or/and petal(s) of ♂ flower(s) or/and petal(s) of the ♀ flower(s) in the egg chamber.

The following appear to be the main reasons for the selection of only ♂ flowers for nest decoration:

1. Ratio of all the opened and unopened (i.e. flowers and flower buds) ♂ and ♀ flowers
2. Ratio of ♂ and ♀ flowers anthesized at one time
3. Relative lengths of flower pedicel of ♂ and ♀ flowers
4. Shape of flower
5. Relative surface areas of ♂ and ♀ flower petals
6. Formation of abscission layer to facilitate detachment of the flower from the pedicel

Ratio of all the opened and unopened ♂ and ♀ flowers:

I studied the ratio of all the opened and unopened flowers and flower buds of *M. dioica* climbing on various hosts at various localities and got the following results (Table 1).

TABLE 1

Total length of climbing branch	Total No. of ♂ & ♀ flowers & flower buds	No. of ♂ flowers & flower buds	No. of ♀ flowers & flower buds	Ratio of ♂ : ♀ flowers & flower buds
17000 cm	3690	2770	920	3:1

The above shows that ♂ flowers and flower buds are three times more than ♀ flowers and flower buds, thus more easily available.

Ratio of opened male to female flowers:

I observed 5 plants of *M. dioica* at various localities and counted their opened ♂ and ♀ flowers continuously for 4 days. Data collected is as follows (Table 2).

It is clearly seen from the above that while the ratio between ♂ and ♀ flowers stands at 3:1 before anthesis, it may go as high as 10:1 just after anthesis, making ♂ flowers still more easy to collect.

Relative lengths of pedicels of ♂ and ♀ flowers:

Male flowers are selected may be also because they have a longer pedicel which helps the bird to hold them in its bill more easily. ♀ flowers possess a comparatively short pedicel due to the presence of a massive inferior ovary which would make them less convenient to manipulate.

Shape of flowers:

In male flowers, the lower part of the pedicel makes a shallow cup whose centre possess

TABLE 2

Days	Plant No. 1		Plant No. 2		Plant No. 3		Plant No. 4		Plant No. 5		Total No. of flowers	
	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀
1st day	18	3	31	2	94	7	17	11	43	5	203	28
2nd day	26	4	71	3	97	7	19	12	50	6	263	32
3rd day	39	4	66	8	68	3	44	3	45	5	262	23
4th day	46	2	76	3	81	1	53	7	56	6	312	19
Total No. of flowers	129	13	244	16	340	18	133	33	194	22	1040	102
Ratio ♂ : ♀ flowers	9.9	1.0	15.2	1.0	13.3	1.0	4.0	1.0	8.8	1.0	10.1	1.0

fast yellowish-pink colour due to the presence of anthers of the stamens. This is rather an attractive pattern of colours while female flowers are monotonous in colour and lack the cup shaped corolla. In other words, ♂ flowers are more conspicuous and distinctive than female flowers.

Relative surface areas of petals of ♂ and ♀ flowers:

Flowers of *M. dioica* are pentamerous. Average surface area of the petals of ♂ flower is more than of ♀ flower. The average surface area of petals (5 petals) of 5 flowers of each sex taken from the same plant are given below:

No. of flowers	Average surface area of 5 petals of a ♂ flower	Average surface area of 5 petals of a ♀ flower
1st flower	81.0 mm^2	40.8 mm^2
2nd flower	108.0 mm^2	36.8 mm^2
3rd flower	99.7 mm^2	35.5 mm^2
4th flower	87.8 mm^2	37.0 mm^2
5th flower	105.0 mm^2	38.0 mm^2

The broader surfaces of the petals of a ♂ flower attract the male bird from a distance.

Formation of abscisson layer:

If we pull a ♂ fresh or old flower or flower bud holding it by the petals, it detaches from the pedicel just between the calyx and the bracteole very easily. After anthesis each over mature flower detaches from this point situated above the bracteole. This is the specific point where detachment occurs due to the development of abscisson layer. Such a condition does not obtain in the ♀ flowers if they have been pollinated and fertilized. In other words, the plucking of male flowers is easier while female flowers need more exertion.

I suggest these are some of the reasons why the male *P. benghalensis* selects only the *male* flowers of *M. dioica* for its nest decoration.

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16. RECORD OF RUSTIC BUNTING

Several aspects of the record of the Rustic Bunting (*Emberiza rustica*) in the *Journal*, vol. 80 no. 2 p. 417, by Del-Novo and Ewins make me question the uncritical acceptance of this observation.

The writers' claim that they are familiar with this species in the UK gives a very false impression of its status in this country where it is a very rare bird, with an average of only five occurrences per year. I suggest that familiarity with a species can only come with frequent and regular observation. The observers identified the bird as a male from the blackness of the head plumage, but in January the bird would have been in winter plumage when its black markings are mottled with brown.

The most disturbing aspect of the record is that the observers do not appear to be aware of the similarity of Tristram's Bunting (*E. tristrami*) or attempted to eliminate that possibility. It also has a black and white head pattern, a chestnut breast band and flank markings. In winter plumage it could look sufficiently similar to cause confusion. Its normal migratory range includes north east Burma.

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17. THE BIRDS OF DELHI AND MEERUT

Meerut lies 76 kms northeast of Delhi in West U.P. with no record of birdwatching while good birdwatchers have been reporting the avifauna of Delhi for a long time (Ref. Abdulali, H. & Panday, J. D. 1978; Ganguli, Usha, 1975). We have to-day comprehensively good record of the birds in and around Delhi. I have on the other hand carried on observations of the avifauna of Meerut region since 1976 with a special study of the birds inhabiting Hastinapur forest-marsh ecosystem which has revealed some birds not reported from Delhi. It is by no means a comparative study but the presentation of a fact which raises certain pertinent questions about habitat preference of birds. The birds mentioned below are those that apparently do not visit the Delhi area though a distance of some kilometres does not matter to the winged creatures:

1. North Indian Crested Goshawk (144)
(*Accipiter trivirgatus*)

This bird of prey is most conspicuous in the non-breeding months of winter. It has been observed for a long time at Hastinapur since 1978. It prefers to stay at a particular spot at the edge of the forest overlooking the marshes, offering a good view, often perched atop a disused electric pole or on scanty-leaved branch of a tree.

2. Indian Brown Hawk Owl (642)
(*Ninox scutulata*)

This fearless nocturnal bird of prey has been observed at the forest edge at Hastinapur for long periods and is most probably a resident bird. Unlike other wary owls it has allowed closer observation in daytime but is very restive at dusk when it starts giving out its characteristic call heard by me in March.

3. Northern Browncrowned Pygmy Woodpecker (851) (*Picoides nanus*)

This tiny woodpecker has been regularly observed in Hastinapur forest since 1978. If it were not for its movement one could hardly distinguish this brown woodpecker from the brown bark of Seesam tree (*Dalbergia sissoo*) which it prefers to frequent.

4. Jungle Myna (1009)
(*Acridotheres fuscus*)

This myna is common in the long belt of Hastinapur Forest Range. Though a jungle bird it frequents residential dwellings near the forest in search of food. These birds have been observed on restaurant tables at the outskirt of Hastinapur town.

5. Yellowbellied Wren Warbler (1525)
(*Prinia flaviventris*)

A new record of this bird's distribution. I have been observing various aspects of the life of this beautiful warbler since 1980 in Hastinapur marshes. It is a resident bird, never leaving the marsh ecosystem to enter the forest or grassland closeby. During the breeding period the bird acquires a darker grey crown and more beautiful yellow underside, while it acquires a shorter tail in contrast to its winter plumage. The presence of this species here leaves only the Thar region separating it from its *sindiana* subspecies in the west of the Indian subcontinent.

6. Striated Marsh Warbler (1548)
(*Megalurus palustris*)

This large bird, also being observed since 1978, is a resident bird of Hastinapur marshes never leaving its marsh habitat at any time of the year. It is a resident bird which is only conspicuous by its calls increasing in frequency as winter ends and the breeding season approaches. Its breeding synchronizes with that of Striated Babblers (*Turdoides earlei*) in the marshes overgrown with *Typha elephantina, Phragmites karka* etc.

7. Whitetailed Bushchat (1699)
(*Saxicola leucura*)

A new record of the distribution of this species. I have studied its biology and life history during 1980-83 which has revealed most interesting aspects of the change of plumage of males during breeding season and also of juveniles as they grow to maturity. In winter plumage the bird is easily confused with the migrant Collared Bushchat (*Saxicola torquata*).

8. Hodgson's Pied Wagtail (1887)
(*Motacilla alba alboides*)

This subspecies of Pied Wagtail is a regular winter migrant to Meerut region. It has been observed to choose the same locality for its winter stay every year.

9. Finn's Baya (1960)
(*Ploceus megarhynchus*)

The existence of this resident baya at Hastinapur noticed by me establishes a new record of its distribution. I have observed its breeding since 1979 and have noticed as many as 35 nests at one time during June and July atop a defoliated Seesam tree in the marshes. During the breeding season the birds acquire beautiful plumage particularly the males in bright yellow gold, but the species is difficult to identify in the field in the nonbreeding plumage.

Besides these birds that have been regularly noted in Meerut region, there have been some others not noted in Delhi that were observed only once, and their irregular occurence here has been very interesting. I am keeping an eye over their possible recurrence, if any, The following are such irregular migrants, if this word can be used for them.

1. Greyheaded Lapwing (365)
(*Vanellus cinereus*)

Five of these winter migrants were observed near the marshes of Hastinapur in March 79 on a very cold, wet day. The birds were not immature for they had distinct pectoral band.

2. Pied Flycatcher Shrike (1065)
(*Hemipus picatus*)

Two of these birds, never known to occur in the north of peninsular India, were observed in Hastinapur in Dec. 1980 in a small wooded patch overlapping the marshes. Their status in this region could at best be only occasional or stray.

3. Blackheaded Cuckoo-Shrike (1079)
(*Coracina melanoptera*)

In August 1981 a pair of this cuckoo-shrike was observed feeding its two juveniles at the edge of forest at Hastinapur. The birds preferred *Acacia catechu* trees in and around which they hunted insects. The presence of juveniles though enigmatic indicates its breeding in or near this region and I am on the look out for its recurrence. If it proves resident bird here, it will be a new record of its distribution.

4. Blackbrowed Flycatcher Warbler (1614)
(*Seicercus burkii*)

Several of these small warbler were observed in a small party, hunting insects, in the undergrowth at the edge of Hastinapur forest in March 1979. Their sighting was clear and unmistakable but their occurrence can at best be explained as stray in this region.

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18. THE EFFECT OF GRAZING ON THE ABUNDANCE AND DIVERSITY OF BIRDS IN SCRUB VEGETATION AT NATHDWARA, RAJASTHAN

INTRODUCTION

Grazing pressure on pasture and forest lands in India has increased steadily over the past century, with the rapid increase in the populations of cattle, sheep and goats (Chopra 1965, Centre for Science and Environment 1982). The intensity of grazing affects the structure and species composition of the vegetation (Puri 1965, Whyte 1968). If grazing pressure has altered the vegetation of certain areas we may therefore expect long-term changes in their characteristic avifauna, perhaps leading to the local disappearance of certain species.

To study the effects on bird populations of changes in vegetation brought about by grazing I conducted observations on rocky, scrub-covered hillsides in the vicinity of Nathdwara, Rajasthan in November 1983. In this region many areas of rocky hillsides had been enclosed by stone walls about 1 m high to exclude grazing animals. The animals, principally cattle and goats, had free access to adjacent areas with similar slopes, aspects, soil and geology. All enclosures had been constructed during the past few years and no difference was apparent between the tree and shrub vegetation inside and outside the enclosures. However, the ground vegetation differed considerably between the two treatments.

By making a series of comparable observations in both enclosed and unenclosed areas I sought to demonstrate the effect that differences in the ground vegetation had on local bird populations. Because the only difference between enclosed and unenclosed areas was their accessibility to domestic grazing animals, I considered that any differences detected would indicate the effect of grazing intensity on the distribution and abundance of the local avifauna.

STUDY AREA AND METHODS

The country around Nathdwara is situated at 500-700 m above sea level, with a semi-arid climate, receiving more than 90% of its annual precipitation of *c.* 700 mm during the monsoon months of June to September (Basu 1965). During my stay from 1-8 November daily maximum temperatures ranged from 25-29°C and daily minimum from 15-18°C. The 1983 monsoon was a good one, with rainfall higher than average over Rajasthan as a whole. Although no figures were available for Nathdwara it was clear from the state of tanks and reservoirs that precipitation had been abundant.

Observations were carried out on rocky hillsides with slopes exceeding 5° within 4 km of Nathdwara. The geology of the area consists of archean rocks of the Aravalli system, locally consisting mainly of metamorphosed limestones. Over most of the area covered soils were very thin or non-existent, the only accumulations being in the valley bottoms which I did not include in my observations.

All observations consisted of paired line transects, one inside and one outside the walled enclosures. Each pair was carried out as close together in time and space as possible, so that they covered ground with the same slope, aspect and geology at the same time of day. I performed seven pairs of transects between 1 and 8 November 1983.

All transects lasted 15 minutes and covered about 0.5 km. Each involved walking slowly in a straight line between pre-selected points and counting all birds within an estimated 20 m of the transect route. A different area was selected for each transect so that no ground was covered more than once. Only birds seen perched on the ground or on vegetation were included, hence aerial insectivores, such as swallows, swifts and bee-eaters, were mainly ignored. Four pairs of transects were carried out between 0820-1035 hrs local time and three between 1615-1730 hrs.

RESULTS

Vegetation

No significant differences were found between the enclosed and unenclosed areas in the dominant species of woody vegetation, the most important being *Euphorbia roylei, Acacia* spp. and *Zizyphus nummularia.* The proportion of ground area covered by shrubs and tree canopy was likewise similar, ranging from 5-20% in both treatments. Ground vegetation outside the enclosures consisted of a variety of herbs and grasses up to 0.2 m high, including several spinous perennial cushion plants. Ground cover ranged from 20-50%. Inside the enclosures the ground vegetation was dominated by grasses from 0.3-1.3 m high with ground cover ranging from 70-100%. In a few places inside the enclosures the grasses had been cut for hay, but these harvested areas amounted to no more than 10% of any transect.

Species richness

During the course of all transects twenty-one species of birds were recorded inside the enclosures and sixteen species outside. Only eight species were common to both treatments. Inside enclosures a mean of 6.29 + 1.98 (s.d.) species per transect was recorded, whereas outside the mean was 4.71 + 2.69 species per transect. Fourteen species were recorded on only one transect and only nine were recorded on three or more. This suggests that my samples were not adequate to record all the species potentially occurring in the area.

Numbers of birds

The mean numbers of birds of all species seen on transects within the enclosures was 13.57 + 7.35 birds per transect. Outside the enclosures the corresponding figure was 7.57 + 4.12 birds per transect, significantly lower (t=2.88, d.f. 12, $P<0.05$). The difference is in the opposite direction to that which we might have anticipated considering the relative detectability of birds in the two treatments. Hence we can probably conclude that bird densities are higher in the enclosures than outside them.

Species composition

Considering only those species recorded on three or more transects, it is evident that certain species showed a preference for a particular treatment (Table 1). Those exclusively recorded in the enclosures were the Red-vented Bulbul and the two species of Wren-Warbler. The Pied Wheatear and Brown Rock Chat, in contrast, were recorded exclusively on transects outside the enclosures. Only the three most numerous species; Little Brown Dove, Indian Robin and Lesser Whitethroat, were well represented in both treatments.

TABLE 1

NUMBERS OF TRANSECTS IN ENCLOSED AND UNENCLOSED AREAS ON WHICH THE NINE MOST COMMON SPECIES WERE RECORDED

Species	Enclosed	Unenclosed
Little Brown Dove *Streptopelia senegalensis*	6	3
Red-vented Bulbul *Pycnonotus cafer*	4	0
Large Grey Babbler *Turdoides malcolmi*	1	3
Indian Robin *Saxicoloides fulicata*	6	4
Brown Rock Chat *Cercomela fusca*	0	5
Pied Wheatear *Oenanthe picata*	0	6
Plain Wren-Warbler *Prinia subflava*	5	0
Rufous-fronted Wren-Warbler *Prinia buchanani*	4	0
Lesser Whitethroat *Sylvia curruca*	5	2

DISCUSSION

The results of my transects suggest that unrestricted grazing and a consequent dearth of ground vegetation on unenclosed areas lowers the number of birds present, at least at the time of year when I made my observations. It also probably reduces the diversity of species and changes the habitat to suit ground-feeding birds, such as the Pied Wheatear and Brown Rock Chat, at the expense of Wren-Warblers and other species which favour dense vegetation.

The change from a luxuriant seasonal development of ground vegetation, as seen in the enclosures, to a very small amount of ground cover, as seen outside the enclosures, is one that must have taken place over large areas of India within the last millenium in response to the gradual increase in the human population and its domestic flocks. We can probably assume that this has led to a corresponding change in bird populations. For migrants the impact of these changes will also have been experienced on their breeding grounds, where the size of breeding populations may have altered in response to changes in the availability of wintering habitat.

Because the well-vegetated enclosures appear to support a greater diversity of birds than unenclosed areas we can probably assume that an increase in grazing pressure has been associated with a general decline in the diversity of birds in areas supporting the type of semi-arid ecosystem characteristic of northwestern and central India. I have already suggested elsewhere that the distribution of rare and local passerine birds in different ecogeographical regions of India and Pakistan provides evidence that such a process has been at work for some time (Gaston 1984).

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19. SIGNIFICANCE OF RESIDUAL EGG-FLUID TO HATCHING PATTERNS IN THE GHARIAL (*GAVIALIS GANGETICUS*) AND EMYDID FRESHWATER TURTLES (REPTILIA; CROCODILIA AND CHELONIA)

(*With a text-figure*)

INTRODUCTION

Reptiles were successful as land vertebrates over the amphibians mainly due to evolution of the egg with extraembryonic fluid. Therefore, conservation and maintenance of this fluid all through the development from egg-laying to hatching is of high significance to a species.

The significance of retention or otherwise of the egg-fluid at hatching in two primitive groups of reptiles — the gharial and the emydid turtles — are discussed in this work.

MATERIALS AND METHODS

The interpretations presented in the following are based on extensive observations carried out on hatching patterns of the gharial and turtles in the wild and in captivity (simulated hatchery). Captive observations were made at the Gharial Research and Conservation Unit, Tikkerpada, Orissa and the Gharial rearing project at Deori, Madhya Pradesh, and observations in the wild were carried out in the National Chambal Sanctuary and Satkoshia Gorge Sanctuary.

OBSERVATIONS

1. Gharial eggs weigh approximately 157 g and increase to 200 g before hatching while the eggs of the emydid turtles that were studied weigh 57.42 ± 0.9 g (*Kachuga kachuga*), 44.21 ± 5.23 g (*Kachuga dhongoka*) and 21.40 ± 1.056 g (*Kachuga tentoria circumdata*), and do not show any appreciable change in the weight towards end of incubation.

2. Full-term developed and newly emerged hatchlings of *G. gangeticus*, *K. kachuga*, *K. dhongoka* and *K. t. circumdata* weigh 75.3 ± 5.4 g, 29.85 ± 1.732 g, 23.42 ± 6.873 g and 11.91 ± 1.677 g respectively.

3. The difference in the pre-hatching egg weight and the hatchling weight are due to

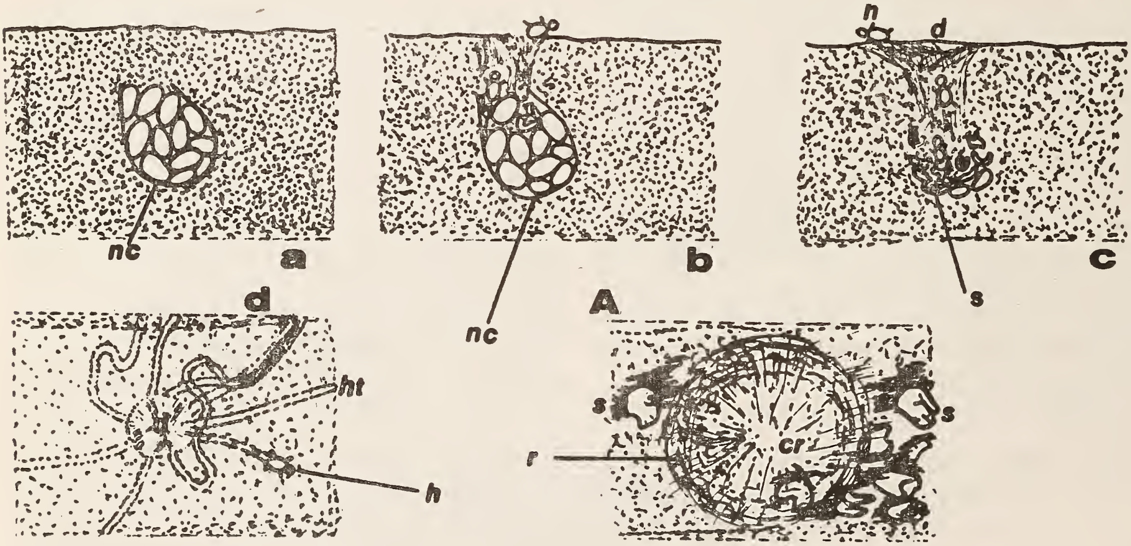

Fig. 1. (a-c): Diagramatic cross section view of a large emydid turtle (e.g. *K. kachuga*) nest chamber (nc) with sequences of hatching showing formation of surface depression (d) as the hatchlings (h) emerge and empty eggs (s) crumple inside the nest chamber. (1d): surface view of a hatched nest showing tracks (ht) formed by hatchlings (h) as these leave through the nest depresion (d). (1A): Surface view of a hatched-out gharial nest showing the crater (cr) and its rim (r) formed after hatching. (s) empty shells that form visual markings.

the weight of shell, shell membrane and residual egg fluid. The residual egg-fluid is over 75 g in the case of gharial while is evident as only traces of 'moisture' in the turtles. Therefore, while turtles hatch dry and neat, the gharial hatch completely wet with considerable amount of egg-fluid.

4. Turtles hatch themselves, without any parental aid. They use the egg caruncle to rupture the shell membrane and then by tearing the membrane with front limbs 'walk-out' of the egg to the surface of the nest (Fig. 1). During this process the egg shells crumple inside the nest chamber and a depression appears on the ground above due to filling in with sand in the space just vacated by the hatchlings.

5. Mother gharial normally responds to the call of the hatchlings during her visits to the nest (Singh and Bustard 1977) and exhumes the nest in order to release out the young ones. During hatching, as the shell flakes off automatically a gharial uses its egg-tooth to rupture the shell membrane (Singh 1975) and then 'wriggles-out' of the egg. The empty eggs, now represented by the cup-like thick shell membrane is made heavy by sand sticking and filling wherever the residual fluid is present. Such heavy empty eggs remain scattered at the hatching site often leading down to the water and are visible from a distance. Some of these eggs also remain covered under exhumed sand of the nest at depths varying upto 30 cm. Signs of hatching can be seen until after a month or the advent of monsoon floods.

DISCUSSION

Based on observations presented in this note, at the time of hatching the gharial still has about 37% (75 g out of 200 g) extra-embryonic fluid unutilised while in the Emydid turtles the egg is almost dry.

Significance: 'Dry-hatching' vs. 'Wet-hatching' —

In the turtles under discussion, where the mother does not have any role in hatching or thereafter, 'dry hatching' is necessary. With this there is no clogging of the nest chamber and all the hatchlings walk out of the nest leaving behind the empty eggs in the nest chamber below surface.

Contrary to the above, in the gharial the residual egg-fluid plays three roles. First, it maintains a turgor pressure (Singh 1979) which helps in proper puncturing of shell membrane (Singh 1975). Second, with the rupture of the shell membrane the slimy fluid helps the hatchling wriggle and slip out of the egg — its legs are far behind and the hatchling cannot use them to open the shell membrane unlike the turtles. Third, because of sand filling into the empty egg (shell membrane pocket) and making it heavy these empty eggs remain at the nesting site for over a month. Even when the empty eggs at the surface are blown off by wind those which were buried earlier get exposed. These white empty eggs act as visual marking — both for the hatchlings and the mother. The hatchlings remain grouped just down the bank where empty shells are lying and the mother appears near such groups of hatchlings. Therefore, these visual markings by empty shells at the hatching site increases the accomplishment of parental behaviour and the survival value of the hatchlings. It is not known, how in the turtles, in the absence of any parental attendance, nature supports hatchling survival.

To conclude, since residual egg-fluid does not have any role in the hatching and subsequent survival of Emydid turtle hatchlings the fluid is completely utilised thereby, simultaneously, negating any possible clogging of 'nest-crater' coming on the way in hatching of young ones from the bottom of the nest chamber. In the gharial upto approx. 37% of the total egg weight remain as residual egg-fluid which have a three-fold function, maintaining pressure inside the egg, providing a slimy medium for hatching and holding empty eggs at the hatching site as visual markers —, that increase the survival value of hatchlings. The retention of fluid for hatching may be considered as an advanced stage in evolution of gharial over the Emydids.

We are thankful to Wildlife Institute of India, Government of India and Wildlife wings of Forest Departments of Orissa and Madhya Pradesh for providing facilities for this study. We record our special appreciation of the assistance received from Sri M. Kulshrestha and Sri Jagdish Goyal during field studies in National Chambal Sanctuary.

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20. THE DISTRIBUTION AND POPULATION OF CROCODILES IN THE PROVINCES OF SIND AND BALUCHISTAN (PAKISTAN)

In the Indian subcontinent, crocodiles have been plentiful in the past. Even gharial, which is quite uncommon these days, had previously good populations. According to Adams (1967), quoted by Whitaker and Daniel (1978), "Gavial abounds in all the great rivers of North India — 10 or 20 may be seen together". Their range extended throughout the Gangetic system, west to Pakistan and north east to Brahmaputra. Similarly, marsh crocodiles were also abundant. Smith (1931) pointed out that Muggar were once extremely common in the former range from river Dasht in the extreme west of Pakistan to Assam in North Eastern India and over most of the Peninsula and Sri Lanka. According to Daniel (1976) marsh crocodile is still wide spread in India occurring in almost all the areas of its known distribution; the gharial however remains the most endangered crocodilian of the subcontinent.

Although marsh crocodiles, being better adaptable are still reported to occur in patches in some of their former habitats in Sind and Baluchistan (Khan and Mirza 1976, Khan and Malik, per. comm.), the last available field report mentioned only 2-3 gharial remaining between the Sukkur and Guddu Barrages (Pelleri, G. 1975).

In Pakistan, scientific surveys have never been carried out before for locating various sites of crocodile occurrence and estimating their population. As the availability of a suitable technique is a pre-requisite for such surveys, I attempted various methods for testing their usefulness under prevailing conditions. These are discussed below:

Methods and Material: Preliminary information on the availability of crocodiles was obtained from the provincial Game Wardens in Punjab, Sind and Baluchistan and other senior forest officers. Indications were positive, therefore, investigations were first started in the province of Sind, Questionnaires were prepared in the local language and sent to all district game wardens in Sind through offices of the Sind Wildlife Management Board (*see* appendix I). These were distributed to Game Inspectors and Game Watchers for obtaining information from the local fishermen, boatsmen, waterfowl hunters and other knowledgeable persons.

The questionnaires when received back were scrutinized and localities where crocodiles were reported, were marked on a map. A survey of such localities was then conducted in February, 1983, searching the reported sites with the help of game staff and local villagers. Crocodiles were counted at their basking sites in Nara canal, Lakes, Dhands using 8 x 40 and 10 x 50 binoculars. This was usually followed by night observations, catching reflection of the crocodile eyes with the help of a search light. At this stage of investigation, no distinction was attempted between juveniles and adults.

Two types of data were collected; number of crocodiles which were actually sighted and counted on that particular day or night, and the number of crocodiles presence of which were either indicated by more than one local villagers or were evident from their signs like faeces, tracks etc.

In Baluchistan, information was obtained from senior forest officers, college teachers and notable shikaris through letters and personal contacts. A wetland when known through the above procedure to have been a previous or known as a present habitat of crocodiles, was visited for obtaining further information from local inhabitants; and when confirmed, the respective sites were then searched and crocodiles counted or estimated.

Similar surveys could not be undertaken in other parts of the country as wild populations are believed to have become extinct several years ago.

RESULTS

Crocodile surveys, conducted in the provinces of Sind and Baluchistan gave the following results:

Provinces	Locality	Number counted	Number estimated*
Sind			
(District Khairpur,	Nara canal	17	120
Nawab Shah	Lakes,		
and Sanghar)	'Dhands'	19	
Baluchistan			
Sibi	Nari Nadi	3	10
Lasbela	Titian Nai	7	—
	Hub river	14	50
	Hub dam	—	5
Makran	Nihang Kaur	11	—**
	Kech Kaur		
	Mirani Dam		

* This is confined strictly to the areas visited personally.

** Crocodile habitats were so widespread that even approximate number was difficult to estimate in this first attempt.

The above results reveal that crocodiles, though uncommon are still available in many parts of Pakistan. Some of these areas have great potential for crocodiles. Nara canal and other lakes in Sind provide not only suitable habitats to the present crocodile populations but in view of their size, have also the capacity to accommodate many more crocodiles, similarly the Hub river and Hub Dam in Baluchistan can hold larger populations.

It is therefore concluded that unless sophisticated equipment and qualified staff is available for accurate population counts of crocodiles, various methods adopted in the above studies could be utilized successfully to discover new sites of crocodilian occurrence and measure any change in their populations.

The present surveys were not expected to yield precise population estimates as they are preliminary in nature. Obviously, it is possible to obtain such information provided more time is given to individual sites for detailed interviews with local knowledgeable persons and more time is spent in surveys and recording observations.

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Acknowledgements

I am indebted to Mr. Mohammad Rafique, Chief Conservator of Forests, Baluchistan, Quetta and Mr. Khan Mohammad Khan, Deputy Conservator, Sind Wildlife Management Board, Karachi for their interest and co-operation in the studies. Mr. Mohammad Shafique, Divisional Forest Officer, Parks and Wildlife, Quetta accompanied me to several localities and provided all possible facilities during surveys. His assistance is gratefully acknowledged.

Thanks are also due to Mr. Mohammad Salim, Divisional Forest Officer, Turbat and Mr. Ahmad Ali, Deputy Registrar, co-operative societies, Turbat who accompanied and guided me to wetlands in Makran and rendered valuable help in the studies. Mr. Manzoor Ahmad, Divisional Forest Officer, Working Plan Lasbella helped me in locating crocodile sites in Hub river and Titian Nai. His help is gratefully acknowledged.

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APPENDIX I

QUESTIONNAIRE FOR OBTAINING INFORMATION ON CROCODILES

Forest Range: Forest Division:
Name & Designation of the Game Official:
Name, occupation and
address of the respondent:
Question

1. Please indicate the sites where more than 5 crocodiles could be seen:
   Marsh crocodiles:
   Number .... Locality ....
   Number .... Locality ....
2. Please indicate if such crocodiles are available in same localities throughout the year.
   Yes/No
3. How many egg-laying sites have you seen so far and where? Indicate localities:
4. Are crocodiles increasing in number or decreasing?
   Increasing/Decreasing
5. If decreasing, please indicate reasons:
   a) They are being hunted.
   b) They are starving.
   c) Their previous habitats are no longer suitable.
6. Where have you seen the biggest crocodile?
   Approximate size .... Month/Year .....
   Locality ....
7. Is it available now? Yes/No
8. What is the best time for spotting the crocodiles?
   Season .... Time ....
9. Could you help in locating crocodiles.
   Yes/No

21. NET-BOUND DEATH OF MARINE TURTLE *LEPIDOCHELYS OLIVACEA* OFF WEST BENGAL COAST DURING 1984-85

It is now known that migration of the olive ridley turtle *Lepidochelys olivacea* into Bay of Bengal off the nesting sites at Gahirmatha beach of Orissa and the islands of Sundarbans, West Bengal commence by late October and the peak is reached by December-January (Silas *et al.* 1984). In this part of the Bay of Bengal extensive fishing also starts by late October.

From a survey during 1984-85 fishing season (October-February) it is recorded that a total of 438 turtles (186 males and 252 females) died following accidental capture in the nets of fishermen operating off-shore Digha, Jaldah and Junput in West Bengal. It is to be stated here that the fishermen usually do not let these turtles free in the sea water but carry these to the shore hoping revival following exposure to air. But again according to them, only 7-8% of such turtles revive. And for this reason in each fishing season a large number of carcases at varying stage of decomposition can be seen at trade sites.

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REFERENCE

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22. A NOTE ON CANNIBALISM IN FRESHWATER SOFTSHELLED TURTLE *TRIONYX GANGETICUS* (CUVIER)

The feeding behaviour of *Trionyx gangeticus* is little known. Fishermen near Narmada and Chambal rivers report that the species scavenge on human corpses. Turtles inhabiting local lakes in Bhopal, Madhya Pradesh feed on fish and molluscs and also take aquatic vegetation mainly the water-chestnut (*Trapa bispinosa*). I report here on the cannibalistic behaviour of a turtle under captivity.

In June 1981, a turtle caught by local fishermen in the Upper lake of Bhopal was brought to our Department laboratory and kept in a tank measuring 1.5 x 0.4 x 0.3 m. The turtle was fed with some aquatic plants for one week after which no food was given. In September 1981, seventeen spoiled eggs of another *Trionyx* were put in the tank. These eggs were consumed by the turtle over a period of 4 days. In September 1982, a second turtle was introduced into the tank. After six months I found that the second turtle had eaten the first (Probably after the latter's death). Only the hardshell and bones were left in the tank. From the above it is evident that *Trionyx gangeticus* can live without food for more than a year and it also consumes meat and eggs of its own species.

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23. A NOTE ON REPRODUCTION IN THE HIMALAYAN PIT VIPER (*AGKISTRODON HIMALAYANUS*)

Although reportedly exceedingly common in some parts of its range (Smith 1943) the Himalayan pit viper (*Agkistrodon himalayanus*) remains poorly represented in the literature. On the reproductive habits of this species, Wall (1910) states: "I do not know the exact mating season, but it is probably in spring — April or May............ and the young are launched forth probably in August and September. What the length of the embryo at birth is I cannot state but it is probably about 5 inches. The species is not very prolific, only 5 to 7 embryos having been observed in a single brood". Telford (1980) provides more definite information citing the example of three females in his collection, from the Northwest Frontier Province in Pakistan, giving birth to 6, 5 and 5 young on 27 August, 6 September and 8 September, 1975 respectively. The average length of the young (N = 14) is given as: snout to vent (SV) 146.9 ± 2.2 mm and tail 24.3 ± 0.9 mm.

On 16 September, 1984 I collected one adult male and one obviously gravid female from a locality known as Pohur Pajan, about 11 km. east of the village of Batkote on the Anantnag — Pahalgam road in the State of Jammu and Kashmir, at an altitude of approximately 2,200 m. One month later, on 17 October 1985 the female — measuring 500 mm total length and weighing 48 g. — gave birth to 2 live and 1 dead young. They measured as follows:

	Sex	Length (in mm.) snout to vent	tail	Weight (in g.)	Remarks
1.	F	150	22	3	—
2.	F	162	20	3	—
3.	M	155	30	3	stillborn

Sexing was done by hemipenes eversion. The young were exact copies of the adults only, more brightly marked. In disposition they were very frisky and struck readily when provoked (unlike the adults), flattening their bodies and rapidly vibrating their tail tips. Efforts to keep them alive failed as they refused to feed.

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WALL, F. (1910): A popular treatise on the common Indian snakes, part XIII, *J. Bombay nat. Hist. Soc.*, Vol. XX, No. 1.

24. UNIQUE BEHAVIOUR OF BULL FROGS

I was reading Vol. 41(3) of the Society's *Journal* for April 1940 and came across Miscellaneous Note No. XVII at page 668 by Mr. H. N. Charrington titled "Snake attacked by frogs".

The above article made interesting reading in view of my own experience early one morning in 1974 at Konta of Bastar District. While on tour I was out for a morning walk at about 6 a.m. The difference between Mr. Charrington's experience and mine were that the snake was a 'Dhaman' and was no less than 3′ long and it actually held a bull frog greenish yellow in colour from behind and about 4 to 5 frogs of the same species were around the frog. The location was a shrub of *Ipomoea* and the water spread about 5′ with a depth of 1 to 1½″.

While the frogs were innumerable and of varied sizes and in water in the case of Mr. Charrington's experience, those in Konta were hardly five and all big and all almost on the ground. These frogs caught hold of the victim frog instead of attacking the snake who started bleeding and appeared greatly in pain due to bites. I wondered why the big frogs did not attack the snake.

I however relieved the frog from its miseries and imminent death by driving the snake away.

I wonder if anyone can throw light on the behaviour of the frogs.

27, MIG Indravati Colony,
Rajatalab,
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July 19, 1985.

R. R. BHAROS

[It appears that the frogs seen by Mr. Bharos were of a breeding congregation and were obviously males trying to mate with the female caught by the snake irrespective of its parlous situation. The note by Mr. Charrington was possibly of a similar occurrence and the frogs that 'attacked' the snake were probably interested in the prey that it was carrying rather than the snake itself. — Editors]

25. THE STATUS OF THE NICOBAR TOADS *BUFO CAMORTENSIS* MANSUKHANI & SARKAR, 1980 AND *BUFO SPINIPES* FITZINGER *IN* STEINDACHNER, 1867

Mansukhani & Sarkar (1980) recently described a new species of toad (*Bufo camortensis*) from Camorta and Nancowry Islands in the Nicobar Islands of India. The species was poorly differentiated from the widely distributed and extremely variable *Bufo melanostictus*; furthermore, the authors overlooked Fitzinger's (*in* Steindachner 1867) description of a toad from the Nicobars more than one hundred years earlier. Herein I present evidence that, if some of the Nicobar toads are indeed recognizable as specifically distinct from *Bufo melanostictus,* they should be known as *Bufo spinipes.*

Fitzinger (1861: 415) first mentioned *Docidophryne spinipes* (a nomen nudum) in a preliminary report on the mammals and reptiles collected by the Austrian Frigate "Novara" on a voyage around the world in 1857-1859. The species was formally described and illustrated in Steindachner (1867: 43, pl. 5, fig. 6-7) and the name was clearly attributed to Fitzinger. Although Steindachner almost certainly prepared the description (see Günther 1867) he used Fitzinger's earlier name and credited him with the species. Consequently, the author of the name is Fitzinger *in* Steindachner, 1867 (see the discussion of *Adenomera andreae,* described in the same fashion, in Heyer 1973).

Bufo spinipes was distinguished from *Bufo melanostictus* on the basis of the presence of a tarsal fold, the long, narrow parotoids, and the noticeably more slender body shape. Steindachner did indicate that the two taxa were very closely related. Günther (1867: 146) casually synonymised *B. spinipes* with *Bufo gymnauchen* Bleeker, described from "Lingga" (=Kepulauan Lingga island group, off the east coast of Sumatra, Indonesia). *Bufo gymnauchen* was later synonymised with *B. melanostictus* by Stoliczka (1870: 157).

Stoliczka (1870: 157) also synonymised *B. spinipes* with *B. melanostictus.* Subsequent authors have followed Stoliczka although none have attempted to analyse variation in *B. melanostictus.*

Mansukhani & Sarkar (1980) described *Bufo camortensis* and distinguished it from *B. melanostictus* by its narrower head, more toe-webbing, and less keratinized dorsal warts. Their characterization of three males and nine females from Camorta and three males from Nancowry is remarkably similar to the description of *B. spinipes* in Steindachner (1867). Although they did not use it as a diagnostic character, Mansukhani & Sarkar reported that a tarsal fold was present in their specimens.

Two problems are immediately apparent: Do *B. camortensis* and *B. spinipes* represent the same species, and is either distinct from *B. melanostictus*? Direct comparison of the types is not possible since the whereabouts of the four syntypes of *B. spinipes* is unknown. They are not currently in the Vienna Natural History Museum (Haupl & Tiedemann 1978), although some other specimens from the "Novara Reise" are. However, the evidence for the conspecificity of *B. spinipes* and *B. camortensis* is strong, based entirely on a comparison of their original descriptions. Both Steindachner and Mansukhani & Sarkar described a slender toad with slightly more toe-webbing than *B. melanostictus.* Although the types of *B. spinipes* do not have precise locality data ("von den Nicobaren"), the "Novara" did stop at the type locality of *B. camortensis* (Camorta) and Nancowry (Gans 1955: 285). Because no characters serve to distinguish *B. camortensis* from *B. spinipes,* I conclude that they represent the same taxon.

Whether the Central Nicobar populations are distinct from *B. melanostictus* is more problematical. *Bufo melanostictus* is apparently present on Car Nicobar, about 150 km north of Camorta (Abdulali 1982) and there is a specimen (USNM 29531) from Great Nicobar, about 150 km south of the central islands. This specimen, along with three (USNM 29528-29, MCZ 25691) from Katchall Island in the Central Nicobars were all previously identified as *B. spinipes* but have been reidentified as *B. melanostictus.* Thus, there is an unusual pattern of distribution among the Nicobar toad(s).

Mansukhani & Sarkar's (1980: 98) contention that *B. camortensis* is less warty than *B. melanostictus* is subjective and difficult to evaluate. Some individuals and populations of *B. melanostictus* can be much less spinose than the "norm" for the species (Stoliczka 1870, Crombie, pers. obs.), so I am inclined to attribute little significance to this character.

The presence of a fairly well defined tarsal fold in the Central Nicobar toads seems to be a consistent difference. Stoliczka's (1870: 157) contention that some mainland *B. melanostictus* have a tarsal fold is confirmed by examination of several hundred specimens in the USNM (U.S. National Museum of Natural History, Smithsonian Institution) collection. However, the fold is usually only weakly defined. Such variation is to be expected in a species that is found from the Indian subcontinent eastward throughout southeast Asia and parts of the Indoaustralian Archipelago.

Mansukhani & Sarkar (1980: 98) characterized the toes of *B. melanostictus* as "half webbed", whereas Boulenger (1880: 306) reported the toes of *B. melanostictus* as "at least half webbed." Stoliczka (1870: 157) argued that the amount of webbing was related to environment, with insular and coastal populations having longer toes and more webbing.

Stoliczka (1870: 157) also attached little importance to the slender body shape of the Central Nicobar toads, saying "I have compared several specimens from Nancowry and Camorta, and cannot detect any specific distinction from *melanostictus*. The more slender form is only a character of young and middle age, though it is sometimes retained by specimens attaining a length of five inches. I have seen such specimens in abundance near Moulmein, on the sea coast at Malacca and the Welesley province."

Abdulali's (1982) comments that the Camorta toads were strikingly paler than *B. melanostictus* and "cold to the touch" are hard to evaluate as systematic characters.

Consequently, there seems to be little evidence to recognize the Central Nicobar toads as distinct from *B. melanostictus*; however a final taxonomic decision must await careful, direct comparison of larger samples from the islands and the mainland, preferably supplemented with data on advertisement call, tadpoles, and osteology. The zoo geographic evidence does not favour an endemic species of toad in the Central Nicobars but additional work needs to be done.

Conclusions

The recently described *Bufo camortensis* Mansukhani & Sarkar, 1980 is a junior subjective synonym of *Bufo spinipes* Fitzinger *in* Steindachner 1867, which is currently a junior synonym of *Bufo melanostictus* Schneider 1799. The evidence for recognition of the Central Nicobar toads as a distinct species is insufficient but if additional data should prove them to be different, the name *Bufo spinipes* is available.

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26. FECUNDITY OF SOME HILL-STREAM FISHES OF GARHWAL HIMALAYA

INTRODUCTION

Studies on fish fecundity form an important aspect of fisheries science. The fecundity of hill-stream fishes of Garhwal Himalaya has not been studied extensively. Baloni (1979, 1980) studied fecundity of *Schizothorax richardsonii* and *Glyptothorax garhwali.*

The term fecundity as used in this paper is defined as the number of ripening eggs found in the ovaries prior to spawning. The reproductive capacity of a population is the function of the fecundity of females. There are inter- and intra-specific differences in fecundity of fishes; the higher or lower rate of fecundity depends on the length, weight and age of the fishes, the weight of the ovary and environmental factors.

MATERIALS AND METHODS

Ripe specimens were used for the study of fecundity of the fish. The number of mature ova with considerable amount of yolk deposition which were ready to be released, were taken for estimating fecundity. For each specimen the weight of the preserved ovaries was noted. A portion of the ovary was then weighed separately and all mature ova contained in the latter were counted, from which the total number of ova in the pair of ovaries was computed.

OBSERVATIONS

In Table 1, the average fecundity of fishes collected during this study is given. The fecundity depends more on the weight of the ovary than on the weight or length of fish.

DISCUSSION

Fecundity forms a very important subject for fisheries science and fish production. Older fish not only produce more eggs because of their large weight and size but also produce larger eggs, as fry resulting from large eggs have better chances of survival than fry hatched from smaller eggs.

Fecundity not only depends on the species of fish but also on environmental factors. Low water temperature affects fish growth by depressing the metabolic rate and reducing food conversion. A similar effect on growth results from inadequate food supply.

According to the present study, the fecundity of *Crossocheilus latius* in the size range 125 mm to 215 mm was ranged between 2420 and 4512. Information available on the fecundity of an allied species, *Crossocheilus diplocheilus* by Das & Singh (1969) and Malhotra & Jyoti (1974) revealed that the fecundity in size range 95 mm to 128 mm and 88 mm to 108 mm ranged from 8424 to 21432 and 1996 to 2780 respectively.

Das & Singh (op. cit.) reported that fecundity of *Labeo dero* in the size range 230 mm to 271 mm ranged between 45650 and 91188. Bhatnagar (1964) reported that the fecundity of *Labeo dero* in the size range 330 mm to 504 mm ranged between 67288 and 710934. In the present study in Garhwal region, the fecundity of *Labeo dero* in the size range 230 mm to 340 mm ranged between 52616 and 85182.

According to Baloni (1979) the fecundity of *Schizothorax richardsonii* in the size range 425 mm to 560 mm was found to be between 8465 and 14316. In the present study the fecundity of this species in the size range 190 mm to 560 mm ranges between 1578 and 14316. In other schizothorachids, such as *Schizothorax niger* (Jyoti & Malhotra 1972) the fecundity in the size range 123 mm to 365 mm ranged between 810 and 13940.

Chaturvedi (1976) observed that the fecundity of *Tor tor* in the size range 400 mm to 800 mm ranged between 49146 and 175886. According to the annual report of Central Inland Fisheries Research Institute, Barrackpore (1960-61), the fecundity of nine specimens in the size range 283 mm to 750 mm ranged between 7000 and 100000. In the pre-study, the fecundity of *Tor tor* in the size range 315 mm to 658 mm ranged between 8400 and 98882.

The fecundity of *Noemacheilus beavani, N. botia, N. montanus* and *N. rupicola* has not been studied earlier. In other cobitids, such as *Noemacheilus kashmiriensis,* according to Das & Singh (1969) and Malhotra & Jyoti (1974), the fecundity in the size range 68 mm to 112 mm and 90 mm to 104 mm was ranged between 3042 and 8290 and from 3600 to 4880 respectively. Malhotra & Jyoti (1974) estimated the fecundity of *Botia birdi* in the size range 88 mm to 119 mm to range between 875 and 10509. Rita Kumari & Balakrishnan Nair (1978) reported the fecundity of *Lepidocephalus thermalis* in the size range 45 mm to 62 mm to range between 4400 and 8200. The fecundity of these four cobitids under study here is less as compared to the fecundity of *Noemacheilus kashmiriensis, Botia birdi* and *Lepidocephalus thermalis.*

Baloni (1980) reported that the fecundity of *Glyptothorax garhwali* in the size range 145 mm to 156 mm ranged between 1138 and 3103. The present study reveals that the fecundity of this species with total length 140 mm to 156 mm ranged between 1025 and 3103. The fecundity of *Glyptothorax brevipinnis alaknandi, G. pectinopterus* and *Pseudecheneis sulcatus* is given in Table 1. The fecundity of none of the sisorid has yet been reported by other workers.

The highest fecundity is recorded in *Tor putitora, T. tor* and *Labeo dero.* But in nature, the juveniles of these species are found in much less numbers. The reason for the low survival rate of these fishes could be manyfold. (1) All the discharged ova do not get fertilised, when the male sheds the spermatic fluid over them. In fast flowing water, this is possible. (2) Sometimes the spawning grounds of these fishes are shallow and due to the heat of the sun and seepage of water, they dry up, killing all the fry and fingerlings.

TABLE 1

Name of species	Range of total length in mm.	Range of weight of fish in mg.	Range of weight of ovary in mg.	Range of total number of ova
Barilius bendelisis	112-140	9113-17215	1015-1612	2120-4125
B. vagra	90-110	5191-10623	806-1345	2075-3576
Crossocheilus latius	125-215	32615-66228	3512-6036	2420-4512
Garra gotyla gotyla	165-212	42615-75025	4115-7811	2612-4675
Labeo dero	230-340	204175-412180	17540-40210	52616-85182
Schizothorax richardsonii	190-560	69418-175150	7375-251150	1578-14316
Tor chilinoides	120-207	17590-83120	713-6533	952-3628
T. putitora	310-645	450000-3815000	38000-412000	9150-95815
T. tor	315-658	350000-4215000	35000-410000	8400-98882
Noemacheilus beavani	76-105	1563-7567	90-748	98-1124
N. botia	81-103	4702-9144	732-1936	3004-4812
N. montanus	66-100	2329-8810	75-1850	130-1805
N. rupicola	56-100	1395-5125	44-835	65-1218
Glyptothorax brevipinnis alaknandi	66-102	2710-5700	65-812	20-585
G. garhwali	140-156	30150-46712	2298-10076	1025-3103
G. pectinopterus	71-110	4120-7120	487-899	205-814
Pseudecheneis sulcatus	114-163	11828-35135	492-1254	194-805
Mastacembelus armatus	262-329	56000-92350	7115-22150	1167-3025

(3) Some of the fertilized ova die due to sudden rise and fall in atmospheric and water temperatures. Sometimes, due to heavy rainfall the spawns from shallow spawning grounds are washed away by the turbulent current. Invariably, the shallow spawning grounds lose their link with the main stream and the fry die when water of the area becomes shallow and warm. The low survival rate of these fishes, is, therefore, due to a number of natural hazards. *Tor putitora* spawns in several situation during the breeding season. Throughout the year, the environmental conditions may not be favourable or conducive for the developing spawn. Due to sudden rise and fall of water temperature and heavy rainfall, the fertilised ova or even fry perish.

On the other hand, some of these fishes have low fecundity but high rate of survival. It may be due to selection of suitable spawning grounds, favourable breeding period, proper fertilization of eggs and favourable climatic factors such as rainfall, water temperature, atmospheric temperature, pH and turbidity etc.

RATE OF SURVIVAL

It has been observed in the present study that survival rate of juveniles of *Schizothorax richardsonii* is highest in these rivers and streams. The fecundity of this fish is also high. The high concentration of population of this species in the streams of this area is due to proper adaptation of the species to the environmental conditions of these streams and selection of suitable breeding grounds. The survival rate of *Tor chilinoides, Barilius bendelisis, B. vagra* and *Mastacembelus armatus* is also good according to their fecundity.

Noemacheilus beavani, N. botia, N. montanus, N. rupicola, Glyptothorax brevipinnis alaknandi, G. pectinopterus, G. garhwali, Pseudecheneis sulcatus lay eggs under stones and, therefore, the chances of getting these ova fertilised are rather remote when the male shed spermatic fluid over them. Sometimes the fertilised eggs get swept away with the torrential flood as is the case in majority of other hill-stream fishes. It has been observed that the fry and fingerlings of many of these species are carried away along with the irrigation water into nearby paddy fields where they die in large numbers when the water evaporates or is absorbed by soil. The fry of *Glyptothorax pectinopterus, G. brevipinnis alaknandi, Pseudecheneis sulcatus* and species of *Noemacheilus* suffer in large numbers in this manner.

Predatory fishes like *Mastacembelus armatus* are also responsible for the low survival rate of juveniles of many species because they feed on the eggs, fry and fingerlings of many fishes like *Noemacheilus* spp., *Barilius* spp. and *Schizothorax richardsonii*, etc.

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27. PISE DAM — AN ECOLOGICAL DISASTER FOR THE FRESHWATER PIPE-FISH *DORYICHTHYS CUNCALUS* (HAM.-BUCH.)

(*With a text-figure & a map*)

Among the fishes displayed at the Taraporevala Aquarium, Bombay, a popular exhibit used to be a freshwater pipe-fish, *Doryichthys cuncalus* (Hamilton-Buchanan), because of its unique shape and swimming habits, and the peculiar breeding behaviour where the male carries the eggs in a brood-pouch on its abdomen.

The pipe-fish was collected from the Bhatsa, a tributary of the Ulhas River near Titvala, a railway station on the Bombay-Nasik line 65 kilometres from Bombay. Another tributary, Kalu, also joins the Ulhas River nearby Titvala. This portion of the river is under tidal influence, the seawater rushing up during spring tides from the dual opening of the Ulhas River near Thane and Bassein.

Pipe fishes, like their cousins the sea horses, are basically marine fishes, but a few species have migrated upstream into rivers where they live in fresh water, in shallows where aquatic weeds abound. The slender body of the pipe fish serves as an ideal camouflage, enabling it to hide in the slender eel-grass (*Vallisneria*).

Doryichthys cuncalus (the trivial name was spelt *cunculus* by Day and Munro, and Rahman has followed this practice) was first described by Hamilton-Buchanan in 1822 (Fishes of the Ganges, page 12) as *Syngnathus cuncalus.* The presence of dorsal, anal and pectoral fins distinguishes the genus from *Penetopteryx* (where all these fins are absent), *Nannocampus* (in which there are no pectoral fins), and *Stigmatophorus, Solegnathus, Halichthys* and *Hippocampus* (which have no tail fin).

The superior cristae of the trunk and tail are discontinuous. The median cristae of the trunk bend down at the anus and are continuous with the inferior cristae of the tail (Fig. 1). There is a rectilinear keel on the opercle. The base of the dorsal fin is not raised. The egg pouch is abdominal, unlike *Syngnathus,* where it is sub-caudal.

Jayaram (1981) lists six species of *Doryichthys* as visiting fresh water, *viz. D. chokderi* Rahman (1976, page 47), *D. cuncalus* (Ham.-Buch., 1822, page 12), *D. deocata* (Ham.-Buch., 1822, page 14), *D. dunckeri* Prashad & Mukerji (1929, page 222), *D. insularis* Hora (1925, page 38) and *D. ocellatus* Duncker. Of these, *D. dunckeri* has been recorded only from Burma, *D. ocellatus* from Sri Lanka, *D. chokderi* from Bangladesh, and *D. insularis* from the North Andaman Is. in the Bay of Bengal. The remaining two species, *viz. D. cuncalus* and *D. deocata,* occur on the Indian mainland and in Bangladesh (*D. cuncalus* also occurs in Sri Lanka).

Of the six species, only *D. chokderi* and *D. cuncalus* have more than 40 rays on the dorsal fin. *D. cuncalus* has 16-18 rings on the body, and 25-27 rings on the tail. The dorsal fin starts on the 15th or 16th trunk ring and extends over 10 rings (sometimes on 11). It has 50-51 rays. (In the specimens in the present collection, there are 53 rays.) A fine ridge runs from between the eyes to the tip

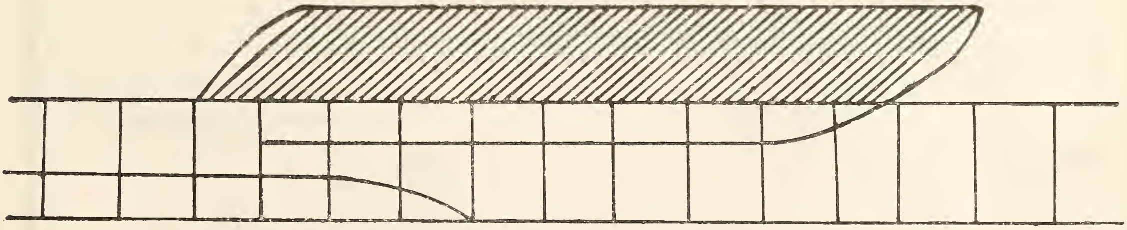


Fig. 1. Region below dorsal fin of *Doryichthys cuncalus* (Ham.-Buch.) showing configuration of the cristae (diagrammatic).

of the snout, and another from behind the eye to over the pectoral fin. The anus is situated on the 17th trunk ring. The superior cristae of the trunk extend to the middle of the tail, and the superior cristae of the tail start from this ring. The tail is 1.8 to 2.0 times in the total length.

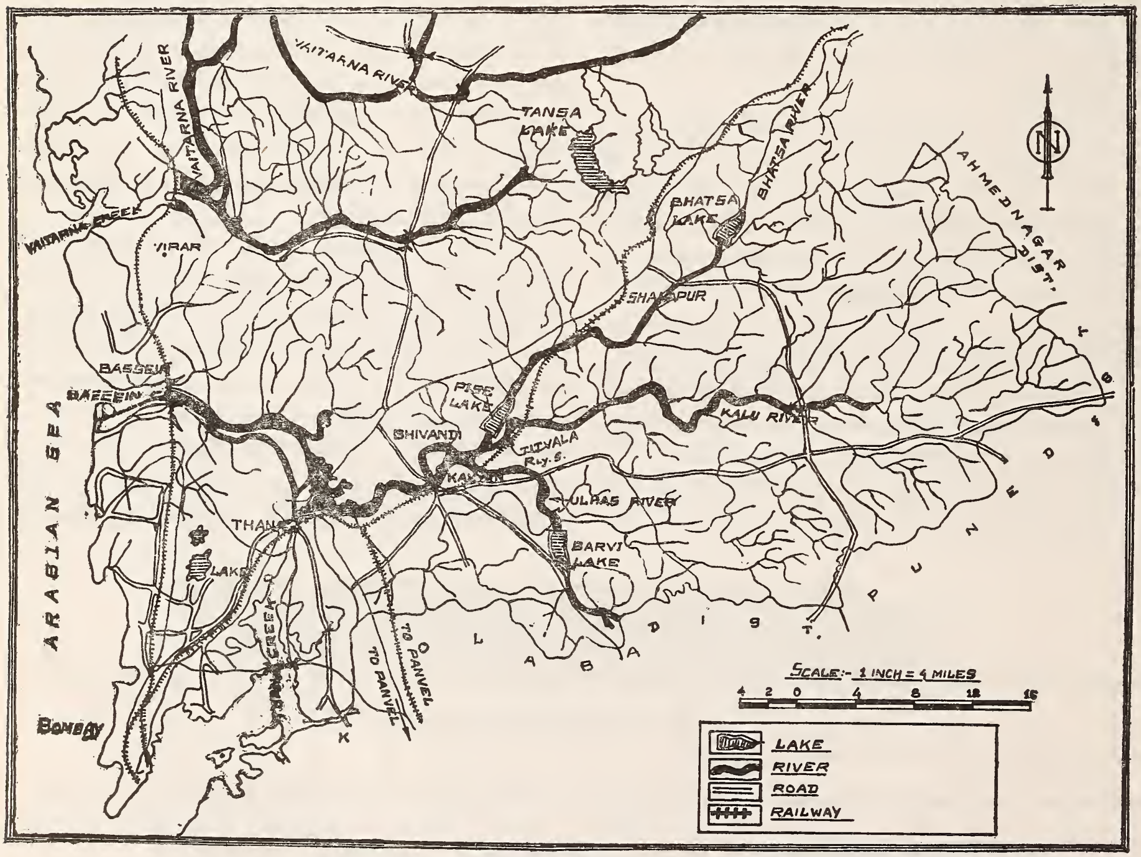
The fin-ray count is : *D.* 50-53; *P.* 16-18; *A.* 2-3; *C.* 8-9.

The total lengths of adults from Titvala vary from 13 to 14.7 cm.

Weber & De Beaufort, in their synonyms for *Microphis brachyurus* (1922, page 44), give *Syngnathus cunculus* Bleeker, *Microphis cunculus* Bleeker, and *Doryichthys bleekeri* Day. But these pipe fishes are not *Doryichthys cuncalus* because the dorsal fin-rays for *Microphis brachyurus,* according to them, number 36 to 48, whereas Day gives the fin-ray count for *D. cunculus* as 50, and Rahman gives 50-51. Dawson (1985), in his book on Indo-Pacific pipefishes, describes it as *Microphis cuncalus.*

D. cuncalus is common in the rivers and estuaries in many parts of India.

The Pise Dam was constructed in 1979 by


VAITARNA RIVER
VAITARNA RIVER
TANSA LAKE
BHATSA RIVER
BHATSA LAKE
N
AHMEDNAGAR DIST.
VAITARNA CREEK
VIRAR
SHAHAPUR
BASSEIN
BASSEIN CREEK
ARABIAN SEA
PISE LAKE
BHIVANDI
KALU RIVER
TITVALA Rly. S.
KALYAN
ULHAS RIVER
THANA
LAKE
BARVI LAKE
THANA CREEK
TO PANVEL
TO PANVEL
KOLABA DIST.
POONA DIST.
BOMBAY
SCALE:- 1 INCH = 4 MILES
4 2 0 4 8 12 16
LAKE
RIVER
ROAD
RAILWAY

Map. 1. Map of western Maharashtra showing location of Pise Dam.

the Bombay Municipal Corporation as an anicut or pick-up weir into which flows the water coming from the Bhatsa Dam. Prior to the impoundment of water above the Pise Dam, *D. cuncalus* could be easily collected in large numbers in the shallows of the Bhatsa River near Titvala, and Kulkarni (1953), in the first of a popular series on Native Aquarium Fishes, named this fish *Syngnathus kalyanensis,* calling it "apparently a new species, and being so far unrecorded." He did not, however, follow up this statement with a detailed description of the fish (personal communication), although he had stated that "a systematic description of this new species is being published separately." In extensive collections in this region over many years, we have never come across any specimens of *Syngnathus* — a genus where the brood pouch is sub-caudal.

Since this fish has not been bred in captivity, it is not known if the young require a sojourn in brackish water in order to grow. If so, the adult would necessarily have to migrate downstream to the estuarine regions where perceptible salinity occurs. Since their natural haunts, in the shallows, are now inundated by the waters rising above the Pise Dam, this pipe-fish, unfortunately, has vanished in these regions. Although common in many rivers in India, its localized occurrence in a limited stretch of the Ulhas River has apparently led to its extermination here.

Four specimens of this pipe-fish have been deposited in the British Museum (Natural History).

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28. *NEMIPTERUS PERONII* (VALENCIENNES 1830) (PISCES: NEMIPTERIDAE) — A NEW RECORD FROM INDIAN WATERS

(*With a text-figure*)

Thread fin breams of the genus *Nemipterus* constitute a commercially important fishery along the Indian coast. The species are chiefly caught by trawl nets, occasionally by hand lines and hooks and lines. Of the twenty species of the genus recorded from the Indo-Australian Archipelago (Weber & de Beaufort 1936), only five are reported from the Indian seas by Day (1878) under the generic name of *Synagris*. They are *S. striatus* (=*N. nematophorus*), *S. tolu*, *S. bleekeri*, *S. notatus* (=*N. hexodon*) and *S. japonicus*. Later, *Nemipterus mesoprion* and *N. delagoae* were also recorded from Indian waters (Sriramachandra Murthy 1978, Rajagopalan *et al.* 1977; Srinivasa Rao & Manikyala Rao *in press*).

Twenty specimens of *Nemipterus peronii* were collected from the hand line catches obtained from the northern fishing grounds off Tuticorin (8°48′N 78°11′E) on 22-1-1980. Hitherto, the species was recorded from the coasts bordering South China Sea (Weber & de Beaufort 1936, Wongratana 1970, Senta & Tan 1975, Weber & Jothy 1977) and Pakistan (Supanovic & Mohiuddin 1973) only. The occurrence of *N. peronii* off Tuticorin establishes the continuity of the geographical distribution of the species, which extends from South China Sea to Western Indian Ocean (Arabian Sea). A comparison of the characters of the species from the three areas, namely Tuticorin, Thailand (Wongratana 1970) and Batavia and Celebes (Weber & de Beaufort 1936) is made to find out whether or not there is any geographical gradation in the characters.

Nemipterus peronii (Valenciennes)
(Fig. 1)

Dentex peronii Valenciennes, in Cuvier & Valenciennes, Hist. Nat. Poissons, VI, 1830, p. 245.

Synagris peronii Gunther, Cat. Brit. Mus., I, 1859, p. 376.

Dentex hypselognathus Bleeker, Versl. Akad. Amsterdam, XIII, (1872) 1873, Revision Dentex, p. 9; Atlas Ichth., VIII, 1876-1877, p. 84, *Synagris hypselognathus* Weber, Sibogan Exp. Fische, 1913, p. 282.

Nemipterus robustus Ogilby, Proc. Roy. Soc. Qleensland, XXVIII, 1916, p. 114.

Nemipterus hypselognathus Herre, Notes Fish. Zool. Mus. Stanford Univ., 1931, p. 55.

Nemipterus peronii Weber & de Beaufort, Fisches Indo-Australian Archip., 1936, p. 357; Munro, Fishes New Guinea, 1967, p. 312.

Description: Size range — 15.6 to 20.8 cm SL D X, 9; A III, 7; Pi, 15-16; V I, 5; C 16-17; L. l. 47-49; L. Tr. 4/12; GR 6

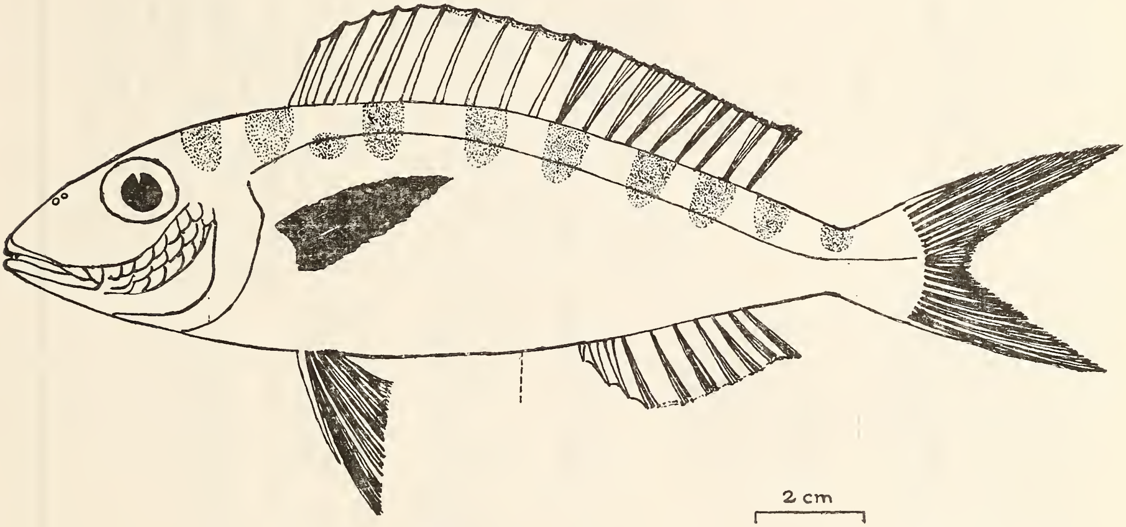

Fig. 1. *Nemipterus peronii* (Val.), 17.1 cm SL.

Body ovate and compressed. Depth of body at ventral origin 3.4-3.9 (3.7)* in SL, 4.3-4.8 (4.6) in TL. Head 3.2-3.4 (3.3) in SL, 4.0-4.3 (4.1) in TL. Snout larger than eye, 2.5-2.8 (2.6) in HL. Eye oblong, 3.2-3.7 (3.4) horizontally, 3.8-4.5 (4.2) vertically in HL. Interorbital space slightly convex, more or less equal to horizontal eye diameter. Postorbital 2.3-2.7 (2.5) in HL. Preorbital smooth, without scales. Suborbital wide, its posterior margin oblique, forming a straight line, when produced, reaches the anterior part of the dorsal fin. Preopercular flange naked, its hind border entire without serrations. A flat, weak opercular spine present.

Mouth slightly oblique, both jaws equal. Maxilla 2.6-2.9 (2.7) in HL, almost reaches anterior margin of eye. Narrow bands of small pointed teeth in both jaws, with an outer row of caninoid teeth and six canines in each jaw in front.

Gill membranes free from isthmus. Six stumpy gill-rakers present on lower half of first gill arch.

Dorsal origin just behind operculum. Dorsal spines not strong, pungent, membrane not emarginate, fourth highest, 2.4-2.6 in HL. Spinous portion slightly higher than soft ray portion. Dorsal base 0.5-0.6 (0.6) in HL. Anal origin just below second dorsal ray. First spine less than half the second, third longest. Spinous portion slightly lower than the soft

TABLE 1

TAXONOMIC CHARACTERS OF *N. peronii* FROM DIFFERENT LOCALITIES COMPARED WITH *N. tolu*

Characters	*Nemipterus peronii*			*Nemipterus tolu*
	Present collections	Wongratana (1970)	Weber and de Beaufort (1936)	
Depth of body in TL	4.3–4.8	—	4.0–4.5	3.8–4.6
Depth of body in SL	3.4–3.9	3.2–3.8	3.2–3.5	3.1–3.6
Head in TL	4.0–4.3	—	4.0–4.2	4.2–4.8
Head in SL	3.2–3.4	3.2–3.4	3.2–3.3	3.4–3.8
	3.2–3.7	3.3–3.4	3.1–3.7	2.9–3.0
Eye diameter in HL	equal to interorbital space which is slightly convex		equal to or slightly more than convex interorbital	slightly concave interorbital, 1.2-1.3 in eye
Maxillary	reaches just before the anterior edge of eye	extends to below front border of eye	reaches to below front border of eye	reaches to slightly beyond anterior margin of eye
Teeth	2-3 narrow bands of small pointed teeth in both jaws, with an outer row of caninoid teeth; 6 canines in each jaw.	villiform teeth in broad bandsiin jaws, larger and laterally; 5-6 canines at upper jaw symphysis	narrow bands of small pointed teeth in jaws, with an outer series of 14 caninoid teeth on both jaws; 6 canines in each jaw in front.	a few rows of conical teeth in anterior part of upper jaw; six curved canines in front of upper jaw only
Suborbital	suborbital wide, posterior margin oblique, forming a straight line, when produced, reaches anterior part of dorsal fin	suborbital not notched, finely rugose, less deep or slender and slightly curved upward postereodorsally	posterior angle of suborbital obtuse, hindborder oblique forming a straight line when produced reaches interior part of dorsal fin	posterior angle of suborbital obtuse and rounded, its hindborder forming a straight line when produced, reaches anterior part of dorsal
Preopercular flange	naked, with hindborder having no serrations	prepercle posterior edge entire	hindborder of preoperculum smooth or slightly crenulate	hindborder of preoperculum smooth
Squamation on head	begins between eyes just before posterior margin of eye	—	scales begin on head before hindborder of eye with an ill-defined temporal band of 4 scales	begins just before hindborder of eye

Table 1 (Contd.)

Dorsal spines	fourth highest, equal to postorbital part of head	fourth to sixth longest	second to fourth of equal length, slightly shorter than fifth to eighth, which are equal to postorbital	fourth to sixth spines longest, equal to eye and snout together
	interspinous membrane not emarginate	—	interspinous membrane between spines slightly emarginate	interspinous membrane deeply emarginate
Anal spines	first spine less than half the second, third longest	third spine slightly longer than second one	first about half as long as second, third longest, equal to eye diameter of shorter	first half length of second, third longest, equal to eye
	spinous portion lower than ray portion	—	soft anal rays longer than third spine	soft anal scarcely deeper than spinous portion
Coloration	head and body rosy, silvery shining on belly	head and body pale irridiscent pink, bright silvery beneath	preserved specimens — reddish above, silvery below with indications of broad yellow longitudinal bands on sides.	head and body rosy with silvery shining beneath
	nine pale pink blotches on the back, beginning in predorsal region	back with 9 ill-defined crossbands, first and second on predorsal region, last one on caudal peduncle	—	8-9 indistinct darker saddles on back, first one crossing nape, second before dorsal fin third to seventh below dorsal base, eighth to ninth on caudal peduncle
	dorsal margin from sixth spine to last ray yellowish	dorsal edge from sixth dorsal spine to tip of last ray pale yellow	—	dorsal edge with orange yellow

TABLE 1

TAXONOMIC CHARACTERS OF *N. peronii* FROM DIFFERENT LOCALITIES COMPARED WITH *N. tolu*

Characters	*Nemipterus peronii*			*Nemipterus tolu*
	Present collections	Wongratana (1970)	Weber and de Beaufort (1936)	
Depth of body in TL	4.3–4.8	—	4.0–4.5	3.8–4.6
Depth of body in SL	3.4–3.9	3.2–3.8	3.2–3.5	3.1–3.6
Head in TL	4.0–4.3	—	4.0–4.2	4.2–4.8
Head in SL	3.2–3.4	3.2–3.4	3.2–3.3	3.4–3.8
	3.2–3.7	3.3–3.4	3.1–3.7	2.9–3.0
Eye diameter in HL	equal to interorbital space which is slightly convex		equal to or slightly more than convex interorbital	slightly concave interorbital, 1.2-1.3 in eye
Maxillary	reaches just before the anterior edge of eye	extends to below front border of eye	reaches to below front border of eye	reaches to slightly beyond anterior margin of eye
Teeth	2-3 narrow bands of small pointed teeth in both jaws, with an outer row of caninoid teeth; 6 canines in each jaw.	villiform teeth in broad bands in jaws, larger and laterally; 5-6 canines at upper jaw symphysis	narrow bands of small pointed teeth in jaws, with an outer series of 14 caninoid teeth on both jaws; 6 canines in each jaw in front.	a few rows of conical teeth in anterior part of upper jaw; six curved canines in front of upper jaw only
Suborbital	suborbital wide, posterior margin oblique, forming a straight line, when produced, reaches anterior part of dorsal fin	suborbital not notched, finely rugose, less deep or slender and slightly curved upward postereodorsally	posterior angle of suborbital obtuse, hindborder oblique forming a straight line when produced reaches interior part of dorsal fin	posterior angle of suborbital obtuse and rounded, its hindborder forming a straight line when produced, reaches anterior part of dorsal
Preopercular flange	naked, with hindborder having no serrations	prepercle posterior edge entire	hindborder of preoperculum smooth or slightly crenulate	hindborder of preoperculum smooth
Squamation on head	begins between eyes just before posterior margin of eye	—	scales begin on head before hindborder of eye with an ill-defined temporal band of 4 scales	begins just before hindborder of eye

TABLE 1 (Contd.)

Characters	Present collections	Wongratana (1970)	Weber and de Beaufort (1936)	*Nemipterus tolu*
Dorsal spines	fourth highest, equal to postorbital part of head	fourth to sixth longest	second to fourth of equal length, slightly shorter than fifth to eighth, which are equal to postorbital	fourth to sixth spines longest, equal to eye and snout together
	interspinous membrane not emarginate	—	interspinous membrane between spines slightly emarginate	interspinous membrane deeply emarginate
Anal spines	first spine less than half the second, third longest	third spine slightly longer than second one	first about half as long as second, third longest, equal to eye diameter of shorter	first half length of second, third longest, equal to eye
	spinous portion lower than ray portion	—	soft anal rays longer than third spine	soft anal scarcely deeper than spinous portion
Coloration	head and body rosy, silvery shining on belly	head and body pale irridiscent pink, bright silvery beneath	preserved specimens — reddish above, silvery below with indications of broad yellow longitudinal bands on sides.	head and body rosy with silvery shining beneath
	nine pale pink blotches on the back, beginning in predorsal region	back with 9 ill-defined crossbands, first and second on predorsal region, last one on caudal peduncle	—	8-9 indistinct darker saddles on back, first one crossing nape, second before dorsal fin third to seventh below dorsal base, eighth to ninth on caudal pedunele
	dorsal margin from sixth spine to last ray yellowish	dorsal edge from sixth dorsal spine to tip of last ray pale yellow	—	dorsal edge with orange yellow

ray portion. Anal base 1.6-1.8 (1.7) in HL. Pectoral long, pointed, origin just behind lower angle of operculum, 1.4-1.6 (1.5) in HL. Ventral 1.3-1.6 (1.5) in HL, first ray does not reach anal origin. Caudal deeply forked, no filamentous prolongations, least depth of caudal peduncle 3.5-4.2 (3.7) in HL.

Scales on preoperculum cycloid in three oblique rows. Squamation on head begins between eyes just before posterior margin of eye. Scales on operculum and body ctenoid.

Colour when alive: Head and body rosy, silvery shining on belly. Nine pale pink blotches on the back beginning in the predorsal region, darkest blotch just at the lateral line origin. Body with inconspicuous lateral stripes. Cheek and operculum with yellow tinge. Dorsal rosy. Dorsal margin from sixth spine to last ray yellowish. Anal milky white with faint yellow streaks. Pelvic and its axillary scales whitish. Pectorals rosy. Caudal rosy, fork margin reddish and lower margin whitish.

Table 1 shows that there are few or no distinguishing features in the morphometric characters of *Nemipterus peronii* described here and elsewhere (Thailand, Batavia and Celebes — Wongratana 1970, Weber and de Beaufort 1936).

Nemipterus peronii and *N. tolu* can be readily distinguished from other Indian species namely, *N. nematophorus*, *N. hexodon*, *N. bleekeri*, *N. japonicus*, *N. delagoae* and *N. mesoprion* by its very oblique posterior margin of suborbital. The posterior margin of suborbital in *N. peronii* and *N. tolu*, when extended, forms a straight line with the anterior part of the dorsal. *N. peronii* and *N. tolu* also share the characteristic feature of having nine saddles (blotches) on the back, which are absent in the other nemipterid species.

Nemipterus peronii, however, differs markedly from *N. tolu* in the following characters.

1. *Teeth*: six curved canines are present in the front of upper jaw only in *N. tolu*; six curved canines are present in the front of each jaw in *N. peronii.*
2. *Height of spinous dorsal*: deeper in *N. tolu* than in *N. peronii.*
3. *Spinous dorsal*: emarginate in *N. tolu*; no emargination in *N. peronii.*

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29. *CYNOGLOSSUS LACHNERI* MENON (PISCES: CYNOGLOSSIDAE) — A NEW RECORD FROM INDIAN WATERS (BAY OF BENGAL, OFF VISAKHAPATNAM)

Menon (1977) while reviewing the systematics of *Cynoglossus* spp. from Indian waters held that thirteen species remain valid, after considering the synonymies of the species reported earlier. Three specimens of *Cynoglossus* sp. collected from the trawl catches off Visakhapatnam were found to be different from the species occurring in the Indian waters as described in the monograph by Menon (op. cit.). These specimens were found to bear a close resemblance to *C. lachneri*, described as a new species by Menon (op. cit), who reported their occurrence from the waters off East Africa, Arabia and Red Sea (Mozambique coast northward to Red Sea and Gulf of Oman and eastward to Anjouan and Nossi-Be Islands and Seychelles). Their occurrence in the Bay of Bengal of the east coast of India extends their distributional range eastwards. Since the occurrence of *C. lachneri* in Bay of Bengal is a new record a detailed description is given, and compared with the description given by Menon (op. cit.) (Table 1).

Material: Three specimens (17.1-25.0 cm SL) were collected from trawl catches, landed at Visakhapatnam fishing harbour (Two specimens on 28.ix.80 from a trawler whose fishing operations extended up to Paradip in the north and one specimen on 24.x.81 from a trawler whose fishing operations were limited to the coast off Visakhapatnam).

Description: Depth of body 24.56-25.67 (M*=25.01), length of head 19.60-21.63 (M=20.65) per cent of SL. Diameter of eye 10.20-10.86 (M=10.62), interorbital width 8.10-8.69 (M=8.29) per cent of HL. Two nostrils on ocular side, anterior one tubular, on the upper lip, situated almost vertical through the anterior border of upper eye, posterior one a simple opening, in anterior half of interorbital space. Two nostrils on blind side, the tubular anterior one on the anterior half of the upper lip, the posterior a little higher and above posterior half of upper lip. Snout rounded, 32.60-35.13 (M=34.14) per cent of HL. Rostral hook rather short, scarcely reaching vertical through front border of lower eye. Maxillary extending beyond hind border of lower eye; angle of mouth extending below

*M = mean of the range.

vertical from posterior border of fixed eye, distinctly nearer to tip of snout than to branchial opening; snout to angle of mouth 43.47-46.93 (M = 45.44), angle of mouth to branchial opening 52.17-56.75 (M=54.67) per cent of HL.

Scales: Ctenoid on ocular side, except those on lateral lines; scales on blind side and those on lateral lines of ocular side cycloid.

Lateral Line System: Two lateral lines on ocular side, mid lateral line with 103-107

TABLE 1

COMPARISON OF MORPHOMETRIC AND MERISTIC CHARACTERS OF SPECIMENS OF *C. lachneri*, OFF VISAKHAPATNAM WITH THE DESCRIPTION GIVEN BY MENON (1977)

S. No. Character	Region	
	Bay of Bengal (East Coast of India)	East Africa, Arabia and Red Sea
1. Depth of body (% of SL)	24.56-25.67 (M=25.01)	24.62-27.19 (M=25.95)
2. Length of head (% of SL)	19.60-21.63 (M=20.65)	17.48-23.14 (M=19.43)
3. Diameter of eye (% of HL)	10.20-10.86 (M=10.62)	7.41-10.89 (M= 9.34)
4. Interorbital width (% of HL)	8.10- 8.69 (M=8.29)	6.98- 9.76 (M= 8.20)
5. Snout length. (% of HL)	32.60-35.13 (M=34.14)	28.40-34.26 (M=31.47)
6. Snout to angle of mouth. (% of HL)	43.47-46.93 (M=45.44)	45.73-50.00 (M=47.02)
7. Angle of mouth to branchial opening. (% of HL)	52.17-56.75 (M=54.67)	50.00-55.81 (M=52.84)
8. Mid lateral line scales on ocular side.	103-107	100-111
9. Interlinear scale rows.	15-16	16-18
10. Dorsal fin rays.	111-113 (M=112)	113-121 (M=117)
11. Anal fin rays.	91-93 (M=92)	92-98 (M=96)
12. Caudal fin rays.	10 in two specimens.	10 in seven specimens.
13. Vertebrae.	55-57, comprising 9 abdominal and 46-48 caudal elements in 2 specimens (radiographs).	55-58, comprising 9 abdominal and 46-49 caudal elements in 7 specimens (radiographs).
14. Coloration (in preserved specimens).	Dorsally uniformly dark brown, lower whitish in two specimens collected on 28-9-80. Upperside light brownish with irregular dark patches on body and an irregular darker patch on operculum, lower whitish in specimen collected on 24-10-81.	Dorsally uniformly dark brown, lower whitish.

scales, 15-16 scales between two lines. Two lateral lines on blind side.

Fins: Dorsal with 110-113, anal with 91-93 rays, caudal 10 in two specimens (In the third specimen caudal showed signs of regeneration).

Vertebrae: 55-57, comprising 9 abdominal and 46-48 caudal elements in two specimens (radiographs).

Coloration:

Specimens collected on 28.ix.80: In fresh condition, ocular side brownish with darker and somewhat round blotches, blind side whitish. Fin rays yellowish. Formalin preserved specimens uniformly dark brown on ocular side, whitish on blind side. Specimen collected on 24.x.81: In fresh condition, ocular side yellowish brown with somewhat darker irregular patches distributed on the body and fins. An irregular dark patch on opercular region. Fin rays yellowish, blind side whitish. Formalin preserved specimen light brownish with irregular darker patches on body and fins, an irregular dark patch on opercular region on ocular side, whitish on blind side.

Diagnosis: The present specimens agree with the description of *C. lachneri* given by Menon (1977) in all respects, excepting the slight variation observed in the case of interlinear scale count and extension of the lower range of dorsal fin rays and anal fin rays (Table 1). These differences may be attributed to geographic variation.

REMARKS: Norman (1934), citing the results of the experiments conducted by Sumner (1911), Mast (1916), and Kuntz (1918) showed that flat fishes posses remarkable powers of changing their coloration, to simulate the substratum on which they lie. The variation in coloration among the specimens of *C. lachneri* collected at Visakhapatnam shows their variability in relation to the possible changes in the nature of the substratum.

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We are thankful to Prof. P. N. Ganapati, Honorary Professor, Andhra University, for his interest and encouragement. We thank Dr. C. C. N. Murty, Head of the Department of Zoology, Andhra University, Waltair, for providing research facilities. One of us (MRM) thanks the C.S.I.R., New Delhi, for the award of Senior Research Fellowship.

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* Original not seen.

30. NEW RECORD OF THE TERMITE *MICROCEROTERMES ANNANDALEI* SILVESTRI (ISOPTERA: TERMITIDAE: AMITERMITINAE) FROM RAJASTHAN

INTRODUCTION

Microcerotermes annandalei was originally described from Berkuda Island, Chilka lake, Orissa State by Silvestri (1923) and has been subsequently reported from other localities in Orissa and Bihar, India by Margabandu (1934), Snyder (1949), Rattan Lal and Menon (1953), Roonwal and Sen-Sarma (1956) and Prashad *et al.* (1966). This species has been collected for the first time from Rajasthan, thus extending the known range to Western India.

Material:

One vial with 1 dealate, 5 soldiers and 2 workers from Sariska Forest, Alwar district, Rajasthan; Coll. N. S. Rathore; 18.vi.1983; Ex- Dry trunk of date palm tree, mixed with other termite species (*Amitermes belli*).

Measurements:

Body measurements (in mm) of 1 dealate from Rajasthan. Body-length (without wings) 4.70; Head length with mandibles 1.28; without mandibles 0.78; Maximum width of the head (with eyes) 0.83; Height of head 0.40; Maximum diameter of compound eye 0.21; Maximum diameter of lateral ocellus 0.08; minimum eye ocellus distance 0.06; pronotum length 0.42; width 0.65. Body measurements (in mm) of 3 Soldiers from Rajasthan. Total body length with mandibles 4.65-5.0; Head length with mandibles 2.55-2.66; without mandibles 1.65-1.72; Head width 1.00; Height of head 0.78-0.80; Mandibles length 0.90-0.94; Postmentum (median) length 0.93-1.00; Maximum width 0.32-0.34; Pronotum length 0.33-0.35; Width 0.58-0.64; Antennal segments 13.

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31. HISTOLOGICAL STUDIES OF SCARLET RED PATCH INDUCED BY THE WHITEFLY *BEMISIA TABACI* (GENNADIUS) ON UNDERSURFACE OF LEAF OF *ACHYRANTHES ASPERA* LINN.

(*With a photograph and two text-figures*)

The whitefly *Bemisia tabaci* is a well known pest of cotton, tobacco and cassava and also a vector of virus diseases in many crops. It has been established by Mound (1963) and also by David & Ananthakrishnan (1976) that considerable variations could occur in the structural details of the pupal case of *B. tabaci* and *Trialeurodes rara* in relation to the nature of the leaf.

On *Achyranthes aspera,* the aleyrodid *Bemisia tabaci* has been found to cause beautiful scarlet red irregular patches on the undersurface of the leaves (hypophyllous). These patches are solid parenchyma emergences from the epidermis and appear more or less circular, fleshy and granular or rugulose in shape (Mani 1973). In a small clear area in the patch the nymph of *B. tabaci* is seen lodged surrounded by the parenchyma emergences (Photo. 1). The size of the patch measures around 1-5 mm in diameter. This type of infestation on *A. aspera* is noticed throughout India, particularly during the monsoon periods.

The histological study of the scarlet red patch induced by the whitefly *B. tabaci* on undersurface of leaf of *A. aspera* is reported here.

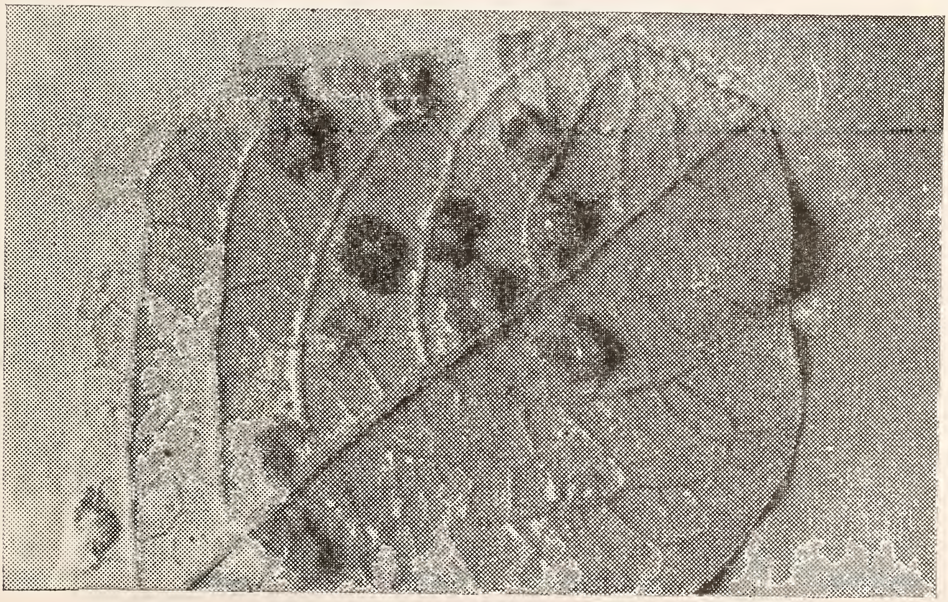


Photo 1. Nymph of *Bemisia tabaci* surrounded by parenchyma emergence on *Achyranthes aspera.*

MATERIAL AND METHODS

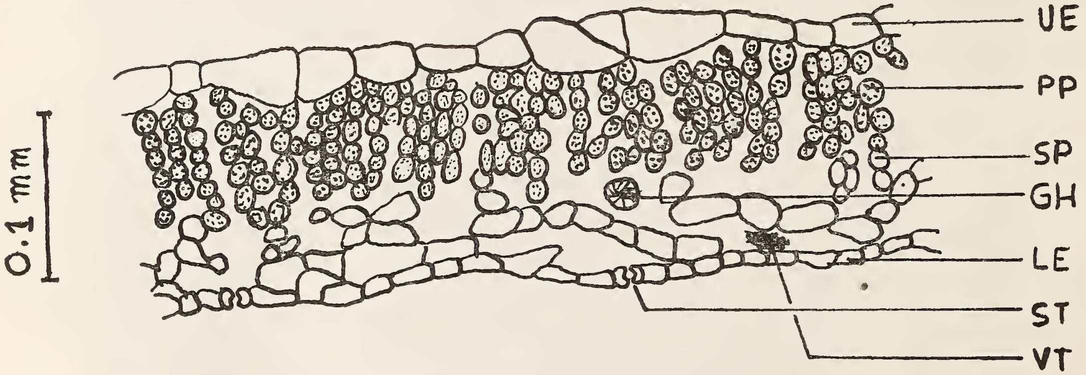
Small bits of scarlet red patches were neatly cut from the leaves of *A. aspera* and fixed in formalin, acetic acid and 70% ethyl alcohol (FAA) in the ratio of 5:5:90. After keeping the leaf portions for 24 hours they were processed following the standard procedure adopted for studying the histology of leaf tissues (Jensen 1962).

Sections of ten micron thickness were obtained by use of rotary microtome. Staining of the cells were done using safranin and fast-green, cleared and mounted on a clean glass slide using DPX mountant. The slides were then observed under Carl Zeiss compound microscope and camera lucida diagrams were made.

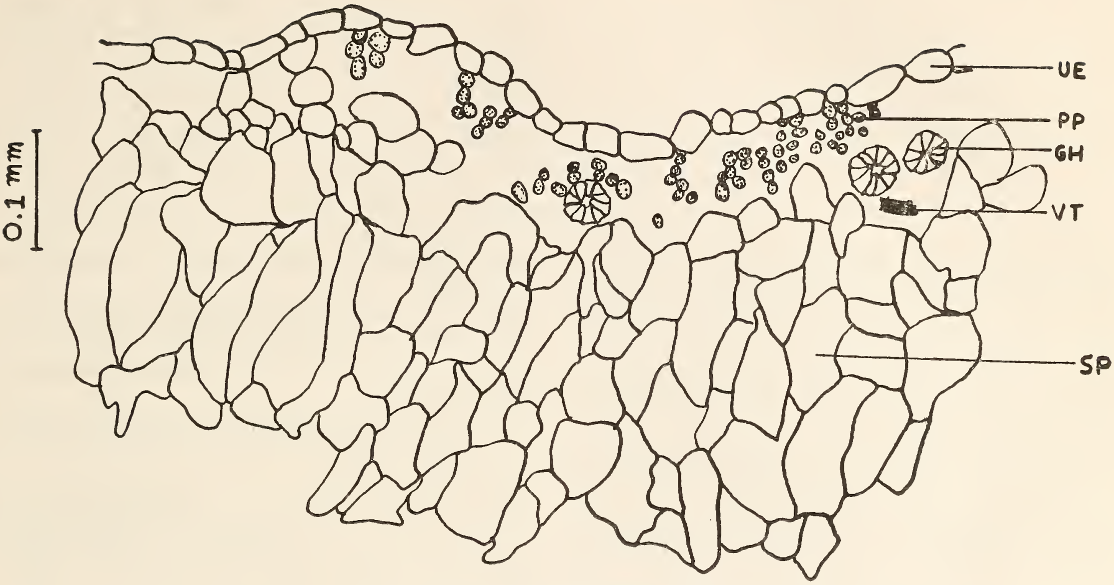
RESULTS

Normal leaf (Fig. 1). The upper epidermis consists of rectangular shaped cells. Next to the epidermal layer is found the palisade parenchyma consisting of 3 to 6 rows of darkly stained spherical cells with chloroplasts. Below the palisade parenchyma the spongy parenchyma is present with large air spaces between the cells. Two to three yellowish brown glandular hairs are noticed occupying the junction of palisade and spongy parenchyma layer. The lower epidermis consists of rectangular cells and harbours stomata in a few places. Epidermal hairs are also present. The mesophyll contains the vascular tissues.

Leaf with patchy region (Fig. 2). The cells of the upper epidermis are slightly larger in size. The palisade parenchyma is greatly reduced compared to the normal leaf and in some places it is almost absent. However, the spongy parenchyma occupies two third of the leaf tissue in the patchy region consisting of about six rows while it is one to three rows in the normal leaf region. The cells of the spongy parenchyma are three to four times greater in size (61.17-86.38 μ) than the cells of the spongy parenchyma (18.51-24.68 μ) present in the normal leaf. Their shape is highly irregular. Glandular hairs are more in number in the patchy region. Vascular bundles are scarce in



C. S. of leaf of *Achyranthes aspera.*
Fig. 1. Normal leaf. (UE — Upper epidermis; PP — Palisade parenchyma; GH — Glandular hair; SP — Spongy parenchyma; LE — Lower epidermis; ST — Stomata; VT — Vascular tissue.)



C. S. of leaf of *Achyranthes aspera.*
Fig. 2. Leaf with patchy region. (UE — Upper epidermis; PP — Palisade parenchyma; GH — Glandular hair; SP — Spongy parenchyma; VT — Vascular tissue.)

this region. The cells of the lower epidermis are isodiametric in the place of origin of the patchy region which gets completely obliterated and its place is occupied by the spongy parenchyma.

DISCUSSION

Of the nearly 700 Indian plant galls reported by Mani (1959), the aleyrodids constitute not even one per cent, thereby clearly indicating their ineffectiveness as gall makers.

The scarlet red patch lodging the aleyrodid nymph *B. tabaci* (=*B. achyranthes*) was first reported by Singh (1931) followed by Rao (1958). A similar type of pink coloured fleshy emergence on *Ruellia prostrata* Poir. induced by *B. tabaci* was also reported by Mani (1959, 1973). Histological studies of the pitgalls of aleyrodid is restricted to that of Krishnamurthy *et al.* (1973) on *Morinda tinctoria* caused by *Indoaleyrodes pustulatus* and concluded that whiteflies are very poor gall makers.

The present study is the first attempt on the histology of patch-like emergences induced by *B. tabaci.* The study clearly indicates complete suppression of palisade parenchyma and proliferation of spongy parenchyma which is pigmented giving rise to the scarlet red patch like appearance. Further detailed studies are essential to elucidate information as to how the aleyrodid nymph is responsible for the proliferation of tissues into scarlet red patches around the site of feeding and the reasons for development of such pigmented tissue which has not been noticed in any other instance excepting *R. prostrata* though *B. tabaci* is highly polyphagous. There is also need to investigate whether the *B. tabaci* occurring on *A. aspera* is a different biotype.

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32. BIOECOLOGY OF *SPHEDANOLESTES ATERRIMUS* DISTANT (HETEROPTERA: REDUVIIDAE)

(*With a text-figure*)

INTRODUCTION

Certain aspects of the bioecology of the assassin bugs of the scrub jungles of Tamil Nadu including their efficient ecotypical adaptations in their nutrition, reproduction and ethology have been already documented. (Ambrose 1980; Ambrose and Livingstone 1978 a, b, c and 1979 a and b, Haridass and Ananthakrishnan 1980 a and b and Livingstone and Ambrose 1979 a and b and 1984). *Sphedanolestes aterrimus* Distant, is a violaceous black, crepuscular, entomosuccivorous, polyphagous, alate (both sexes) reduviid found in the Azhagarmalai tropical rainforest as well as in the higher altitudes of Maruthamalai scrub jungle, where the tropical rainforest conditions prevail. Both nymphs and adults of *S. aterrimus* were collected from the litter of *Tamarindus indicus* in Azhagarmalai. Nymphal instars of another reduviid, *Sycanus ater* and both adults and nymphal instars of several species of blattids were also found as cohabitants of this species. In Maruthamalai, they were collected from the scrubs as well as underneath stones. The insect was usually found in pairs and a maximum of 9 adults (both sexes) and 4 nymphal instars were found occupying a single microhabitat.

MATERIALS AND METHODS

S. aterrimus is polyphagous and the adult insects collected from the field were reared in plastic containers (12 x 6 x 4 cms) on camponotine ants and house flies. Each batch of eggs was left to hatch in isolation in small plastic containers, provided with wet cotton swabs for optimum humidity. The swabs were changed daily to prevent fungal infection. The nymphs thus hatched were individually reared in plastic containers on house flies and camponotine ants. Observation on their incubation period, stadial period, nymphal mortality, adult longevity, sex ratio and oviposition behaviour were recorded for each case.

Results and Discussion

LIFE HISTORY

Oviposition behaviour:

Egg bright yellow, with white operculum, 1.23 ± 0.01 mm long and 0.666 ± 0.02 mm wide. Operculum 0.168 ± 0 mm in height and 0.344 ± 0.01 mm in width.

S. aterrimus deposited its first batch of eggs at the age of 42 ± 14 days. With the help of cementing material the eggs were glued almost vertically to the substratum, but were not glued with each other. No preference to glue the eggs to the fresh excreta was observed in this species as commonly observed in *Acanthaspis pedestris* (Livingstone and Ambrose 1979 b) and *A. quinquespinosa* (Ambrose 1983).

An oviposition index was worked out (Ambrose and Livingstone 1979 a) by calculating the percentage of egg laying days during the adult life span and found to be 13.69 ± 0.1. An average of 19 ± 5 batches of eggs were deposited with a total number of 71.5 ± 22.5 eggs. Minimum number of egg per batch was 1 ± 0 and the maximum were 6 ± 1.

Unfertilized eggs appeared normal when laid but shrunk within two to three days of deposition as observed in several other Assassin bugs, and they were loosely attached to the substratum, suggesting inadequate secretion of cementing material by the virgin. Neither males nor females exhibited any form of parental care towards the nymphal instars nor did they guard the eggs, as reported by Odhiambo (1959) and Ralston (1977) in other reduviids.

Incubation and stadial periods:

Under optimum humidity (80-85%) conditions the eggs hatched in 9 to 11 days (mean: 10.15±0.15) (Table 1). Virgin's eggs never hatched. Hatching invariably takes place in the afternoon (14-16 hrs). Freshly hatched nymphs were never found to probe the empty

TABLE 1

Sphedanolestes aterrimus: INCUBATION PERIOD AND STADIAL PERIOD IN DAYS

(Number in parentheses indicate the total number of observed individuals; Number in parentheses* indicate the range)

Incubation Period	Stadial Period						
	I-II	II-III	III-IV	IV-V	V-Male	V-Female	Total Stadial Period
10.15±0.15	14±1.12	8.85±0.61	10±0.89	15.25±1.93	20	17.66±1.67	66.66±1.45
(20)	(10)	(8)	(7)	(4)	(1)	(3)	
(9–11)*	(11–21)*	(8–13)*	(8–15)*	(13–21)*	—	(16–21)*	

shells as reported by Breecher and Wigglesworth (1944) in other reduviids.

The stadial periods up to the fifth instars were as follows (Table 1): I instar 11-21 days; II instar 8-13 days; III instar 8-15 days and IV instar 13-21 days. From the fifth instar the male emerged on the 20th day and the female between 16-21 days. The stadial period of second instar was shortest whereas that of the last instar was the longest.

Nymphal instars:

First and second instars are sanguineous and the third, fourth and fifth instars are dark maroon. (Fig. 1).

Head finely pubescent, with straight and

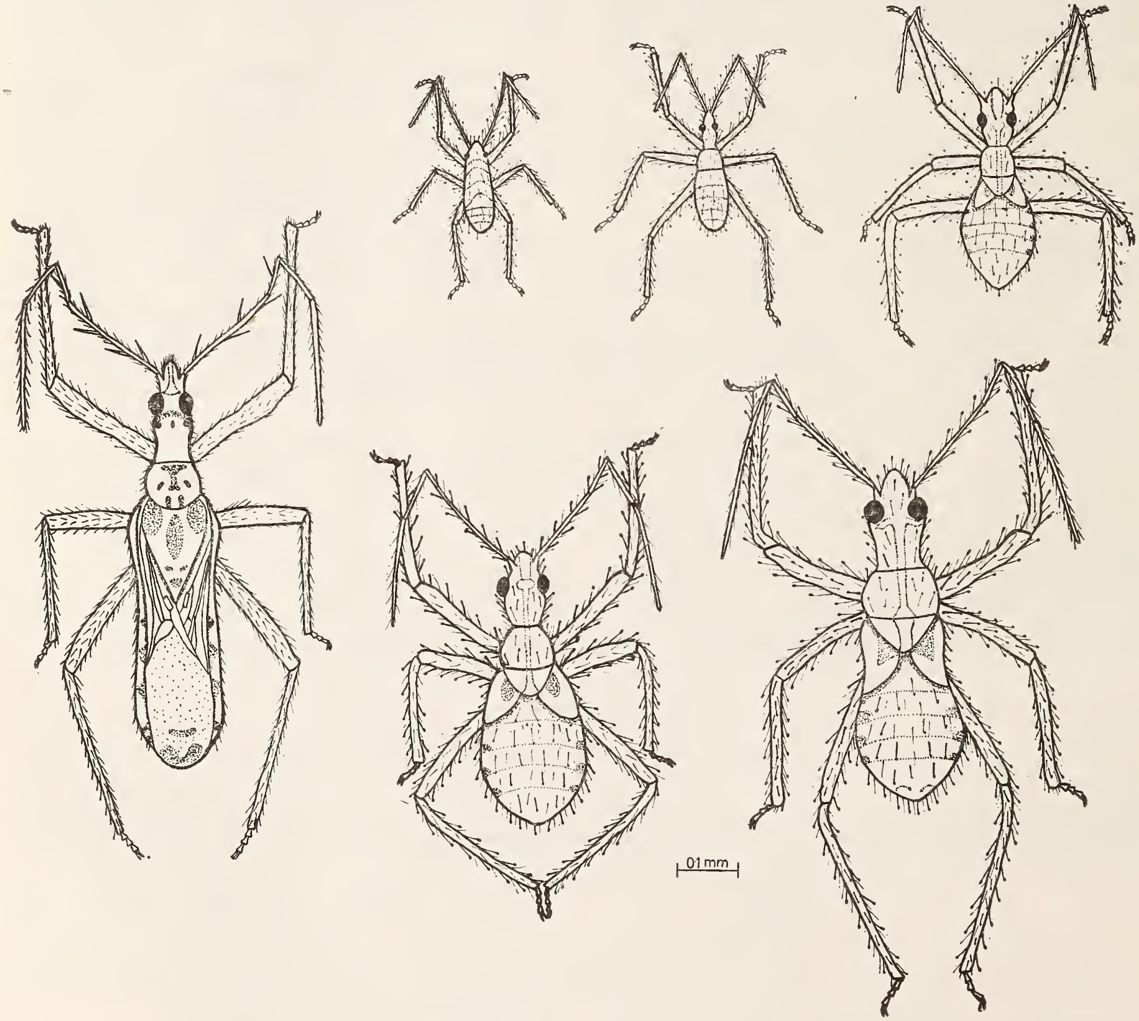

Fig. 1. *Sphedanolestes aterrimus* — Life stages.

clubbed hairs, transverse impression dividing the head into an anteocular and postocular area, the former shorter than the latter in the first two instars, equal in third instar and again shorter in fourth and fifth instars; antennae filamentous, four segmented; pedicel and first flagellar segment shortest and almost equal in length, scape and terminal flagellae segment equal and longest; third rostral segment shortest and the middle segment longest.

Prothorax finely pubescent with straight and clubbed hairs, width greater than length in all stages, mid leg shortest and hind leg longest, tibiae devoid of tibial pads, legs richly pilose with straight and clubbed hairs, length of abdomen greater than its width in all stages.

Feigning death as exhibited by all the nymphal instars is a characteristics feature of this species. The following key was formulated for the identification of nymphal instars.

1. Sanguineous, fore and hind tibiae equal in length .... (2)
   Maroon coloured; fore tibiae subequal in length to that of hind tibiae .... (3)
2. Pedicel and first flagellar segment equal in length, first rostral segment less than twice the length of third rostral segment, width of prothorax slightly greater than its length, width of abdomen less than half its length....First instar

   Pedicel length greater than that of the first flagellar segment, first rostral segment more than thrice the length of 3rd rostral segment, width of prothorax 1½ times greater than its length, width of abdomen 2/3rd of its length........ .... Second instar
3. Wing pads not prominent, anteocular and postocular areas equal in length ......Third instar
   Wing pads prominent, anteocular and postocular areas subequal .... (4)
4. Wing pads not reaching abdominal segments, scape shorter than terminal flagellar segment, pedicel and first flagellar segment equal in length, wing pad thrice as long as its width.......... .... Fourth instar
   Wing pads reaching abdominal segments, scape as long as terminal flagellar segment, pedicel and first flagellar segment subequal in length, wing pad twice as long as its width.......... .... Fifth instar

Nymphal mortality was mainly due to the pronounced cannibalistic tendency among nymphal instars. Abnormalities in hatching and moulting and combat against prey were other reasons for nymphal mortality. 60.71% mortality was recorded in the first instars, followed by 45.45% in second instars. Third and fourth instars recorded 16.6% and 40% mortality respectively. There was no mortality in fifth instar.

Adult longevity:

The longevity of adult female was 138.5 ± 35.5 days. Out of one generation raised from ten first instar nymphs in the laboratory three females and one male emerged. Field studies both at Azhagarmalai tropical rainforest and Maruthamalai scrub jungle also recorded high percentage of females.

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33. MASS AGGREGATION OF THE ARCTIID MOTH *ARGINA ARGUS* KOLLAR (LEPIDOPTERA, ARCTIIDAE) IN CORBETT NATIONAL PARK, KUMAON, U.P.

(*With a text-figure*)

During a visit to Corbett National Park, U.P., in the Himalayan foothills near Ramnagar I came across one of the largest mass aggregations of a moth that I have ever seen. The species was kindly determined as *Argina argus* Kollar (Arctiidae) by Allan Watson at the British Museum (Natural History) who adds that the moth appears to be common. The observations were made in the beginning of April, 1985.

The site, near the Gairal Forest Rest House, was in dense Sal forest (*Shorea robusta*). Though the sal was developing fresh leaves most of the understory bushes and annuals were showing little signs of development. It was exceedingly dry, little rain having fallen since the end of the monsoon last September, as is indeed normal for the locality. The aggregation site differed from the rest of the extensive sal forest in only one respect, there was a water seepage moistening permanently the forest floor, as well as the main road to Dhikala. Individual moths came to drink at the water during the day and especially in the early evening. The presence of Leopard pug marks was not conducive to research after dark!

The moths were assembled in clusters of 50 to 150 individuals on three types of surface. Most were on rounded boulders from the old river bed, many were on tree trunks, and somewhat fewer clustered on the upper- and undersides of large leaves. The moths were packed so tight that the wings of different individuals overlapped; in some cases they even sat on top of each other. There were hundreds of such clusters and the total population, both sexes being present, must have run well into five digits possibly even six.

Except for a few stray individuals and those that came to water, there was no spontaneous flight. However, the individuals were all quite alert, and when disturbed by a handful of pebbles the whole forest exploded into a cloud of moths. The sight of this is very pretty since the moths are 6-7 centimetres across and with prominent pink hindwings. They settled again immediately, rarely being on the wing for more than thirty seconds.

The species is known to feed on *Crotalaria* (Papilionaceae), a plant containing pyrrolizidine alkaloids involved in aposematism in Danaine butterflies. Most Arctiidae are considered to be aposematic, protected species, displaying warning coloration, and this is almost certainly true for *Argina argus* as well. The aggregation is almost certainly a winter and/or dry season roost. One could imagine that the roost enhances the value of being aposematic, but that is unlikely to be the whole explanation. It would appear that the water seepage and perhaps attendant air humidity is a prerequisite for successful quiescence during the non-breeding period in the moths' adult life cycle. Although poorly documented it appears that many Indian butterflies spend much of winter and the dry season in a state of sexual quiescence, some Danaines also doing so in roosts. Although several tens of thousands were observed in this one roost, I

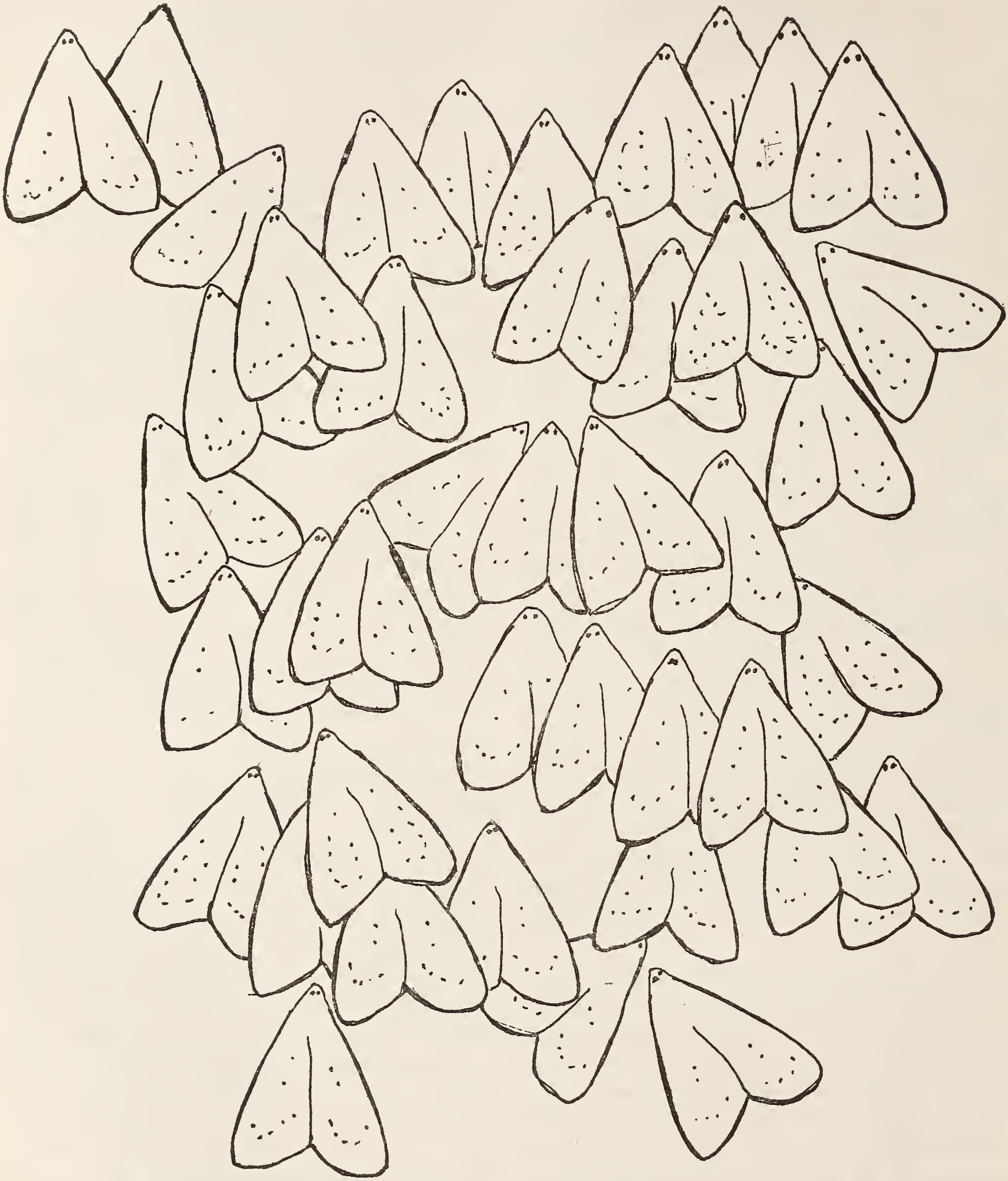

Fig. 1. Aggregation of *Argina argus* on a tree trunk. General aspect in life size after colour slides.

did not see specimens elsewhere during my extensive wanderings in the park. A re-visit to the site in early June showed that the moths had left. I saw a few singles elsewhere in the park.

The Arctiid moth *Panaxia quadripunctaria* Poda in Cyprus shows a similar, but even more dramatic, pattern. Millions assemble in one roost in the small valley locally known as Petaloudes, the Valley of Butterflies. There are indications that virtually the entire Cyprus population of this moth spends the dry summer in this one roost, and then disperses to breed all over the island. It would be extremely useful if the roost in Corbett could be kept under observation throughout a season, and there is great scope for mark-recapture experiments.

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34. MOTHS FEEDING ON LACHRYMAL FLUIDS OF UNGULATES IN SARISKA WILDLIFE SANCTUARY, RAJASTHAN

During field training courses in Sariska Wildlife Sanctuary, Alwar, Rajasthan in November 1984 staff and trainees of the Wildlife Institute of India observed numbers of moths clustered around the eyes of ungulates shortly after nightfall. Careful observation with spotlight and high power binoculars showed the moths to be feeding, with the proboscis inserted over the lower eyelid into the socket.

By good fortune a single specimen was caught when an adult female nilgai ran through dense shrubs causing moths to fly off. The moth was readily identified as a member of the family Noctuidae at the Forest Research Institute, Dehra Dun and appeared similar to the photograph of *Lobocraspis griseifusca* feeding around the eyes of a bovid (Grzimek 1975). The specimen was sent to the British

TABLE 1

TIMING AND INFESTATION OF MOTHS AROUND UNGULATE EYES IN SARISKA
(Two evenings observation in November 1984)

Time	Spotted Deer			Nilgai			Sambar		
a b c	a	b	c	a	b	c	a	b	c
6.00-6.15 p.m.	5	0, 0	—	4	0, 0	—	7	0, 0	—
6.15-6.30	5	0, 0	—	1	0, 0	—	3	1, 33	3
6.30-7.00	1	2, 29	4.5	2	1, 50	20	9	5, 56	2.8
7.00-7.30	4	3, 75	4.0	4	4, 100	8.5	6	6, 100	6.3

a = Number of animals examined
b = Number and percentage of animal infested
c = Average number of moths per infested animal

Museum (Natural History) where it was identified as *Arcyophora trigramma* Hampson; a species poorly represented in the BMNH, but the type specimen was from Mt. Abu in Rajasthan, and a further specimen from Malaysia.

In Sariska on two subsequent nights we looked for the presence of moths on spotlit spotted deer (*Axis axis*), nilgai (*Boselaphus tragocamelus*) and sambar (*Cervus unicolor*). Darkness fell at about 6.05 p.m., but no moths were seen before 6.20 p.m. Data on frequency and intensity of moth infestation are given in Table 1. Data clearly show the pattern of increasing frequency of infestation as night continues; the admittedly small sample giving almost 100% infestation rate from 7.00 to 7.30 p.m. Number of moths per animal showed no discernible pattern. On a return visit to Sariska in the late dry season in July 1985, no moths were seen during three evenings observation.

I noticed no obvious sign of discomfort or irritation even with the maximum number of twelve moths around one eye (nilgai). Eyes remained open and motionless for long periods with several moths stationary and all with their probosci inserted over the eyelid.

Such moths could be the vector of parasites which also use the eye as a host organ, such as nematodes of the conjunctival tubes.

Noctuidae moths have a wide distribution within South Asia, and feed on a variety of hosts. Despite questioning several naturalists and persons familiar with Sariska, I have not learnt of previous sightings there, or elsewhere in India.

I am grateful to Dr. Pratap Singh of the Forest Research Institute and to Dr. M. Honey of the British Museum of Natural History, London for assistance in identification.

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35. ZOOGEOGRAPHY OF INDIAN DACINAE (DIPTERA: TEPHRITIDAE)

(*With two text-figures*)

INTRODUCTION

The flies belonging to subfamily Dacinae (family-Tephritidae) commonly known as fruit flies, are serious pests of nearly all kinds of fruits and vegetables. Dacinae is represented by 166 species belonging to 4 genera from the Oriental region. Of which, 43 species belonging to 2 genera namely, *Callantra* Walker (7 species) and *Dacus* Fabricius (36 species) are

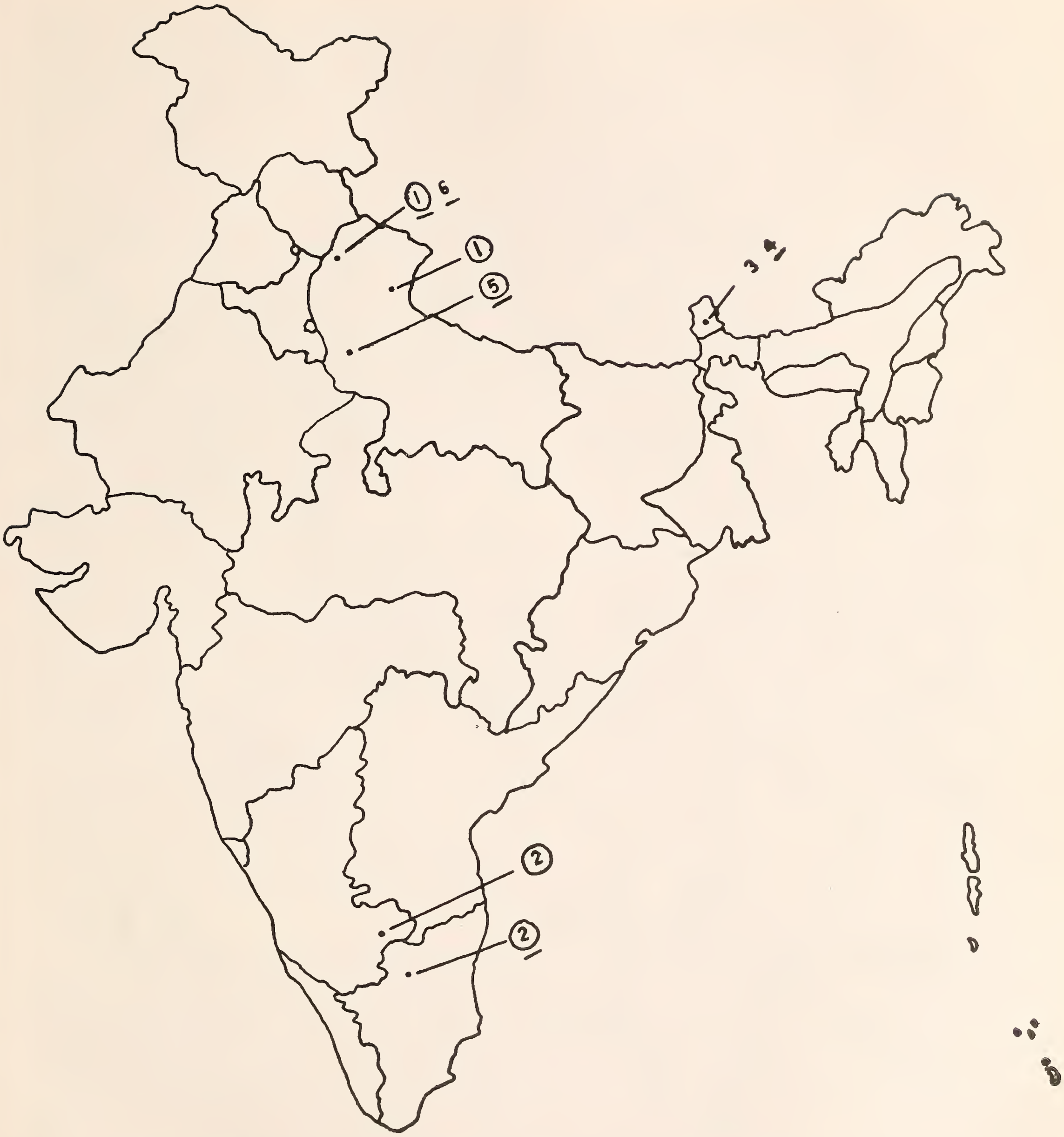

Fig. 1. Distribution of Indian species of genus *Callantra* Walker (encircled number indicate endemic species, underlined number represent its original distribution): (1) *Callantra brachycera,* (2) *C. craboniformis,* (3) *C. eumenoides,* (4) *C. icariiformis,* (5) *C. munori,* (6) *C. sphaeroidalis* (*C. apicalis* not shown due to incomplete information).

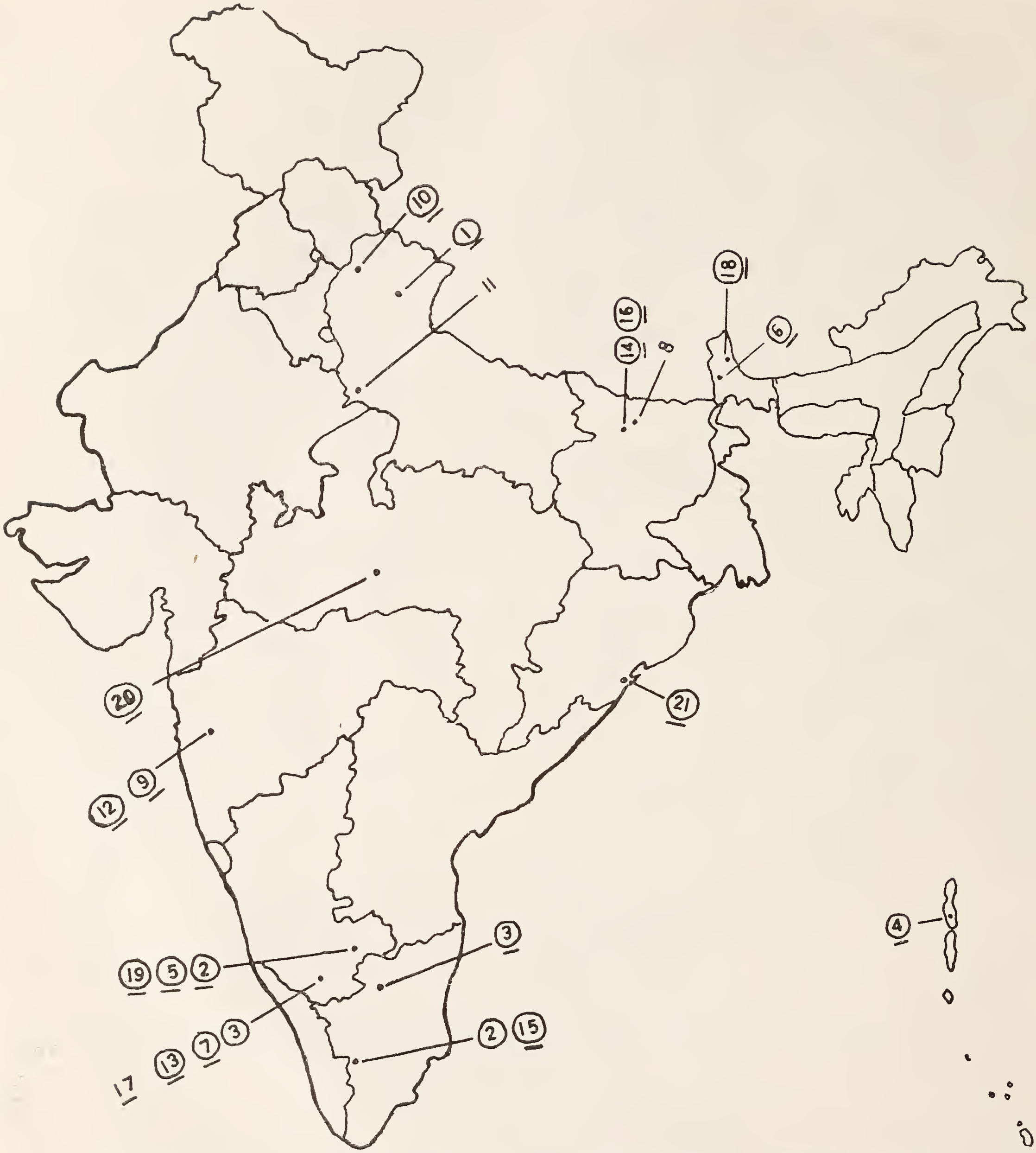

Fig. 2. Distribution of Indian species of genus *Dacus* Fabricius (encircled number indicate endemic species, underlined number represent its original distribution): (1) *Dacus* (*Afrodacus*) *aberrans pallescentis,* (2) *D.* (*A.*) *trilineatus,* (3) *D.* (*Bactrocera*) *affinis,* (4) *D.* (*B.*) *andamanensis,* (5) *D.* (*B.*) *bangalorensis,* (6) *D.* (*B.*) *biguttatus,* (7) *D.* (*B.*) *caryeae,* (8) *D.* (*B.*) *diaphorus,* (9) *D.* (*B.*) *dutti,* (10) *D.* (*B.*) *paratuberculatus,* (11) *D.* (*B.*) *parvulus,* (12) *D.* (*B.*) *poonensis,* (13) *D.* (*B.*) *scutellarius,* (14) *D.* (*Paradacus*) *pusaensis,* (15) *D.* (*P.*) *watersi,* (16) *D.* (*Paratridacus*) *citronellae,* (17) *D.* (*Parazeugodacus*) *bipustulatus,* (18) *D.* (*Polistomimetes*) *minax,* (19) *D.* (*P.*) *oscinae,* (20) *D.* (*Zeugodacus*) *duplicatus,* (21) *D.* (*Z.*) *gavisus* [*D.* (*B.*) *frogatti, D.* (*B.*) *nigrotibialis, D.* (*Paratridacus*) *expandens* and *D.* (*Polistomimetes*) *oleae* not included due to incomplete distributional records; rest of the species are widely distributed throughout India].

known from India. Among Indian species 19 (44.18%) are endemic. A Zoogeographical analysis of Indian Dacinae is presented here.

ZOOGEOGRAPHICAL ANALYSIS

In India sub-family Dacinae is represented by one tribe Dacini, 2 genera namely, *Callantra* Walker and *Dacus* Fabricius and 43 species. Of these 19 are endemic (44.18% endemism). Among Indian Dacinae Oriental element is the most dominant, which is represented by 38 species (88.60%), Ethiopian by 2 species (4.66%), Australian and Palaearctic by 1 species each (2.32% each). *Dacus* (*Zeugodacus*) *cucurbitae* Coquillett is widely distributed throughout the world.

The genus *Callantra* is known by 27 species from the Oriental region, of which, 7 are known from India. Among Indian species *brachycera* (Bezzi), *crabroniformis* (Bezzi) and *munori* (Zaka-ur-Rab) are endemic (42.85% endemism). *C. apicalis* (Shiraki) is known from Burma, Formosa and India, *C. eumenoides* (Bezzi) from Burma, India and Thailand, *C. icariiformis* Enderlein from Burma and India. *C. sphaeroidalis* (Bezzi) is fairly distributed throughout the Oriental region. The distribution of Indian species of *Callantra* is shown in fig. 1.

The genus *Dacus* has 16 subgenera and 137 species in the Oriental region. Among these 10 subgenera and 36 species are known from India. The distribution of Indian species of *Dacus* is shown in fig. 2. Among subgenera *Bactrocera* Macquart is the most dominant (17 species), followed by *Zeugodacus* Hendel (6 species), *Polistomimetes* (3 species), *Afrodacus* Bezzi, *Paradacus* Perkins, *Paratridacus* Shiraki (2 species each), *Didacus* Collart, *Hemizymnodacus* Hardy, *Leptoxyda* Macquart and *Parazeugodacus* Shiraki are known only by one species each. No subgenera is endemic. Among the *Dacus* species 16 are endemic (43.48% endemism). Among the endemic species 15 have not been recorded from any other locality since their original discovery except *D.* (*Afrodacus*) *trilineatus* Hardy (recorded from Bangalore and Kodaikanal) and *D.* (*Bactrocera*) *affinis* Hardy (recorded from Yercaud and Mysore). The occurrence of *D.* (*B.*) *frogatti* (Bezzi) an Australian species is still doubtful in India.

D. (*Bactrocera*) *correctus* (Bezzi), *D.* (*B.*) *diaphorus* (Hendel), *D.* (*B.*) *latifrons* (Hendel), *D.* (*B.*) *nigrotibialis* (Perkins), *D.* (*Hemizymnodacus*) *diversus* Coquillett, *D.* (*Zeugodacus*) *caudatus* Fabricius, *D.* (*Z.*) *scutellaris* (Bezzi) and *D.* (*Z.*) *tau* (Walker) are widely distributed throughout the Oriental region.

Indian Dacinae also show relationship with the corresponding fauna of other regions. *D.* (*Didacus*) *ciliatus* Loew (a serious pest of cucurbits) originally described from Eritrea (Ethiopian region) is widely distributed throughout the Oriental region and has also been recorded from the Palaearctic region. *D.* (*Paratridacus*) *expandens* Walker (an Australian species) has also been reported from India, Malaysia, Singapore, Sri Lanka and Philippines. *D.* (*Leptoxyda*) *longistylus* Wiedemann (an Ethiopian species) is well represented in the Oriental region. *D.* (*Polistomimetes*) *oleae* (Gmelin) (a serious pest of olive fruits), which is a Palaearctic species has also been recorded from Ethiopian and Oriental regions. *D.* (*Bactrocera*) *dorsalis* Hendel and *D.* (*B.*) *zonatus* (Saunders) are the most dominant and serious pests of a number of fruits and vegetables. Both the species were originally described from oriental region, and have a tendancy to become widespread as the former is widely distributed throughout Australian, Neartic, Oriental and Palaearctic regions and the latter has been recorded from Oriental, Palaearctic and Australian regions. *D.* (*Zeugodacus*) *cucurbitae* Coquillett (originally described from Hawaii Islands) is now widely distributed all over the world.

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36. LIFE-HISTORY PATTERN OF THE FRESHWATER LEECH *GLOSSIPHONIA WEBERI* (BLANCHARD) [HIRUDINEA: GLOSSIPHONIDAE]

(*With a text-figure*)

Glossiphoniid leeches suck the body fluids and sometimes devour the flesh of some freshwater snails (Mann 1962, Raut and Nandi 1980) some of which are disease-transmitting species. Considering the potentiality of glossiphoniid leeches in the biological control of the disease-transmitting snails, different workers have studied the ecology and life history of several leech species in the Western countries (Mann 1962, Bay *et al.* 1976). In India, very little attention has been paid to the bioecology of leeches. In recent years, Raut and Nandi (1980, 1984 and 1985) and Raut and Saha (*in press*) have furnished information on the food, feeding and growth rate of the leech *Glossiphonia weberi.* Ray (1980) and Raut (*in press*) have studied the parental care in *Helobdella nociva* and *Hemiclepsis marginata* respectively. Soota *et al.* (1982) supplied the data on the ecology of the leeches of the arid region around Jodhpur. Since *G. weberi* is an effective predator of the disease transmitting snail *Lymnaea luteola* (Raut and Nandi 1980, 1984 and 1985) information on the life history of this leech species, described in this paper, would prove helpful in designing a successful control programme for the vector snails.

Materials and Methods

On December 6, 1984, 15 gravid leeches (*G. weberi*) bearing eggs at different development stages were collected from the pond attached to Indian museum, Calcutta. They were reared in an aquarium under laboratory conditions. The leeches were supplied with juvenile individuals of a freshwater snail *Lymnaea luteola* as their food. Within a week the eggs hatched. Of a total of 30 new born leeches, those which hatched on December 10, 1984 and left their mother on December 12, 1984 were considered for the study of their life history. The young leeches were kept separately in a museum jar measuring 10 x 5 x 5 cm. The jar was filled with pond water up to 7 cm height. As per preference stated by Raut and Nandi (1984, 1985) the leeches were supplied with young *L. luteola* between 3 mm to 6 mm shell size regularly as their food. Throughout the experiment, museum pond water was used. The water in the jar along with the dead and decomposed snails, if any, was replaced regularly to maintain hygienic conditions.

RESULTS

On March 28, 1985 i.e. at the age of 107 days, when the leeches attained 19 mm of their body length, a greenish elongated patch at the mid-ventral region (Fig. 1A) of 21 individuals was visible. In a leech with 11 mm body length at resting state the patch measured 3.5 mm in length located 4.0 mm away from the posterior sucker and 3.5 mm behind the anterior sucker (Fig. 1A). In the remaining 9 individuals the greenish patch formation was completed within the next 28 days. Of the 9 leeches, the greenish patch in two individuals was observed on April 25, 1985 i.e. at the age of 135 days. In all cases, the patches thickened and after 3 days (after the appearance of the greenish patch) the greenish patch transformed into a rounded mass protected by a transparent sac — the cocoon. The cocoon was 1.0 mm in diameter, situated close to the posterior sucker (Fig. 1B). Within the next 20-40 hours from its initiation the cocoon became flattened and the eggs were distinctly visible at this stage (Fig. 1C). They gradually increased in size and on the 3rd day (from the day of cocoon formation) they attained the maximum size. By this time the colour changed to white. Due to the transparent sheath of the cocoon the eggs were visible from outside. The distinctly isolated eggs were

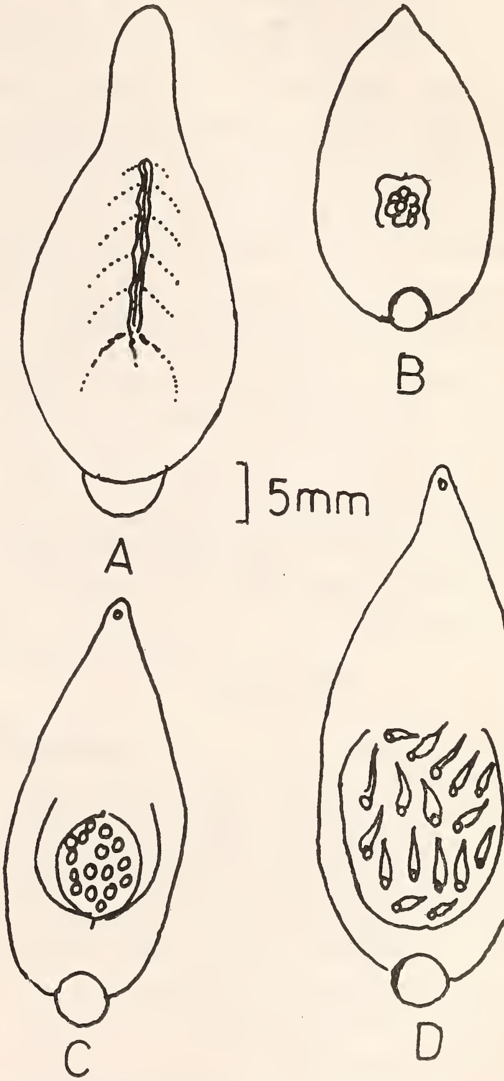

Fig. 1. Formation of eggs and young in *Glossiphonia weberi.*

A. Appearance of greenish patch, B. Cocoon formation (early stage), C. Cocoon (final stage), D. Young ones attached to the mother following hatching.

distributed in a haphazard fashion. inside the cocoon (Fig. 1C). They were counted at this stage. The number of eggs per cocoon varied from 16-38. The eggs were 0.87 mm to 1.24 mm in diameter. The eggs hatched on the 8th and/or 9th day (from the day of cocoon formation). Immediately after hatching the young leech remains attached with the mother at the point of attachment of the egg (Fig. 1D) by a peculiar ball and socket system as has been reported by Mann (1955). At this stage the mother leech did not take any food. They were seen to rest on the wall of the jar and to undulate the body at a regular rhythm.

Finally, on 11th and/or 12th day the young leeches left the mother and started independent life. At this stage they were 3-3.5 mm in length.

The 30 leeches used for this study survived for a period of 6-9 months and produced 2-4 broods. Temperature and pH of water in the jar ranged from 16-36°C and 8.01-8.35 respectively.

DISCUSSION

Data collected on the 30 experimental leeches indicate that *G. weberi* required 107-136 days to complete the life cycle. The leeches attained sexual maturity at the age of 96-124 days and from the formation of eggs up to the release of young 11-12 days are needed. According to Mann (1955) *Glossiphonia complanata* breeds at the age of one year, and the time which may elapse between copulation and cocoon deposition is 8-21 days. *G. complanata* holds the eggs in the cocoon for 5-6 days, holds them by the embryonic attachment organ for 4-5 days and then harbours the young leeches which hold on to their mother by their posterior sucker for up to 14 days so that the whole process occupies about 24 days (Mann 1957). *Theromyzon tessulatum*, on the other hand, may hold the eggs in the capsules for 8-10 days, and then holds them under her body for nearly four months (Mann 1951). In the present study it is clear that *G. weberi* holds the eggs in the cocoon for 7-8 days, holds them by the embryonic attachment organ for 1-2 days and then shelters the young leeches for 2-4 days.

It appears that *G. weberi* and *G. complanata* despite their being the members of the same genus show striking differences in all aspects regarding their breeding. This may be considered as the species specific factor, which most probably, is influenced by the physicochemical parameters of the habitats concerned. In *G. complanata* maturation was accelerated with the rise of temperature as has been noted by Young and Ironmonger (1982).

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37. *IXORA PUBIRAMA* BREM. (RUBIACEAE) — A NEW RECORD FOR INDIAN FLORA

(*With ten text-figures*)

Hooker f. (1880) enumerated 17 species of *Ixora* from British India that included Burma. Bremekamp (1937, 1959), while revising the genus *Ixora* of Burma and Andaman & Nicobar Islands added five species and one variety to this tally, bringing the total to 22 species.

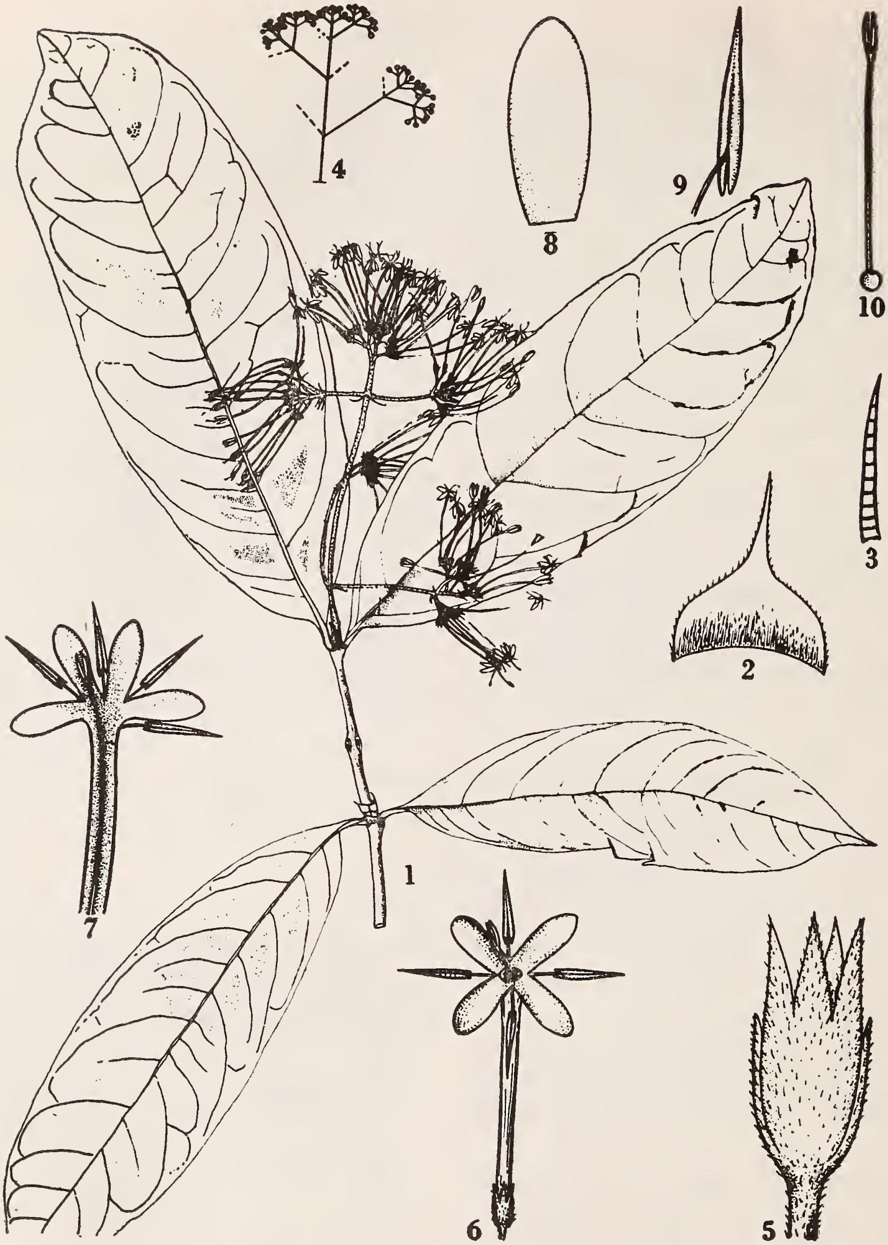
While studying the material of *Ixora* at various Indian herbaria, we came across a number of specimens of *I. pubirama* Brem., a species of Lower Burma, collected from Andaman Islands. These specimens lay misidentified since their collection in 1977.

Ixora pubirama Brem. thus constitutes a new record for the Indian flora and is being described and illustrated in this paper.

Ixora pubirama Brem., Journ. Bot. 75: 173. 1937. *I. cuneifolia* Roxb. var. *puberula* Kurz., Contr. Bur. Fl. 150 et For. Fl. Bur. 2: 21. 1877. *I. puberula* Wall., Cat. n. 6145 (quoted a et b in Herb. Wall.) nomen tuntum; non *I. puberula* (Hiern) Kuntze in Rev. Gen. Pl. *1*: 287. 1892 quoe est *Pavetta puberula* Hiern.

Type: *C. E. Parkinson*, 213 Maymo Herb. (not seen).

Shrub 1-3 m tall, branches pubescent; stem solid, rounded pubescent; internodes 1-8 cm



Figs. 1-10. *Ixora pubirama* Brem.
1. Habit; 2. Inner surface of the stipule; 3. A single hair from the inner surface of the stipule; 4. Inflorescence diagrammatic; 5. Calyx with bracteole and pedicel; 6. Flower; 7. Flower (cut open); 8. A single corolla lobe; 9. Anther with filament; 10. Stigma, style and overy.

long; stipule 7-8 mm long, pubescent all over even on the cusp, under surface hairy; hairs 1-1.2 mm long, multicellular, uniseriate; cusp 3-4 mm long, pubescent. Leaf 12.6-21.3 x 3.9-8.3 cm, simple, opposite, linear-lanceolate, obovate-lanceolate, or oblong obovate, apex acuminate, base acute or slightly rounded, subcoriaceous, upper surface glabrous, lower surface finely pubescent especially on the lateral nerves and the midrib, petioled; petiole 3-13 mm long, channeled, pubescent; reticulately veined with 10-11 lateral anastomosing nerves joining the midrib. Inflorescence peduncled, pubescent, the lower-most bract is supported by a pair of stipules, trichotomous, flowers 100-200 per head; peduncle 1.5-4 cm long, reddish, pubescent; bract 2-10 mm long, the largest bract leaf-like, others linear, acute. Flowers 4-merous, bisexual, white, flowers in trichasia, all the flowers pedicellate except one or two sessile flowers in the cyme; pedicel 1-3.5 mm long, red, pubescent; bracteole 1.2-2 mm long, linear, acute, pubescent. Calyx tube 1-1.5 mm long, sometimes red, pubescent; lobe 1-1.2 mm long, ovate, acute, pubescent. Corolla tube 1.3-2.1 cm long, glabrous; lobes 4-6 x 2-2.1 mm long, linear-ovate, obtuse; stamens 4 alternating with the corolla lobes; filament 2 mm long, glabrous; anther 4-5 mm long, dorsifixed; stigma 2-3.5 mm long, entire or cleft; style 13.9-24 mm long, glabrous.

Specimens examined: Andaman & Nicobar Islands: North Andamans: Arial Bay, ± 25 m, 5 April 1977, *N. P. Balakrishnan* 5473 (PBL); Arial Bay, ± 20 m, 5 April 1977, *N. P. Balakrishnan* 5455 (PBL); Lamia Bay to Kalipur, ± 50 m, 1 April 1977. *N. P. Balakrishnan* 5438 (PBL); Bangladesh: Chittagong Hill Tracts, Sitapahar range, 3 April 2935, *Range Officer* 27 (DD).

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38. THREE NEW DISTRIBUTION RECORDS OF *PYRROSIA* MIRBEL. (POLYPODIACEAE) FROM SOUTHERN INDIA

Pyrrosia Mirbel. is a complex group of Polypodiaceous ferns earlier known under *Polypodium, Niphobolus* and *Cyclophorus.* The genus is mainly distributed in the tropical regions of Africa, Asia and Australia. Ching (1935) has given a systematic account of 40 species and some varieties from Asia. Beddome (1883) treated the genus under *Niphobolus* Kaulf. and described 13 species of which 4 are from southern India. While studying the ferns of Southern India we came across three species of *Pyrrosia,* not reported earlier from the region.

Pyrrosia mannii (Gies.) Ching in Bull. Chin. Bot. Sci. 1: 55. 1935; Baishya & Rao, Fern & Fern allies of Meghalaya 75. 1982. *Niphobolus mannii* Gies. Farngatt. Niph. 107. 1901. *Cyclophorus porosus* C. Chr. Ind. Fil. 200. 1905 (Partim). *Niphobolus fissus* Hook. Sp. Fil. 5: 48. 1863; Syn. Fil. 351. 1867; Handb. 330. 1883 (Partim). *N. floccigerus* Bedd. Ferns Brit. Ind. Suppl. 22. t. 386. 1876.

Epiphytes. Rhizome creeping with fibrous roots and covered by ferruginous brown ramenta. Rhizome scaly, scales narrow-lanceolate 5-7 x 1-1.5 mm, entire. Fronds monomorphus, articulated to small phyllopodia, close, carnose-coriaceous, narrowly oblanceolate, narrowed at base, gradually decurrent on short stipe, acute at apex, 9-20 x 0.5-1.5 cm, greenish with pitted hydathodes above, brown woolly stellate tomentose beneath, veins obscure. Sori copious, admixtured with brown stellate hairs. Sporangia short stalked. Spores oval, yellow.

This species is so far reported only from North India (Ching 1935, Baishya & Rao 1982). It is allied to *Pyrrosia mollis* (Kunze) Ching but can be distinguished by its lanceolate entire rhizome scales and fronds with thicker indumentum. In the case of *P. mollis,* the fronds are densely tomentose and the rhizome scales are lanceolate with ciliate margins. This is the first report of its occurrence from Southern India.

This is not a common species in the area and is seen in moist shady places on tree trunks in association with moss or on decaying bark of dead trees/branches.

Specimens examined: KERALA: Palghat Dt., Karapara Estate Boundary, Nelliampathy R.F., 950 m, 21.12.1980, *N. C. Nair* 69731.

Pyrrosia nayariana Ching et Chandra in Amer. Fern. Journ. 54(2): 62. 1964.

Epiphytes. Rhizome not creeping, about 3 mm thick, scaly, covered by fibrous roots, rhizome scales brown, 2-3 mm long, lanceolate, acuminate at apex broad at base, margin dentate. Fronds linear-oblanceolate, thick, coriaceous, hairy above in young stage, glabrous on maturity, with pitted hydathodes, densely hairy beneath with two kinds of stellate hairs. Midrib prominent. Veins obscure. Fertile and sterile fronds alike. Sori copious, covering beneath in the indumentum. Sporangia long stalked. Spores ovate, verrucose.

The species was originally reported from Imphal, Manipur and the present report from Kerala is very interesting from the phytogeographical point of view. This also forms a new record for south India.

This epiphyte is seen in association with moss on tree trunks in moist shady evergreen forest.

Specimens examined: KERALA: Cannanore Dist., on way to Tirunalli-Arunapparai, ± 750 m, 9.2.1978. *V. S. Ramachandran* 53839.

Pyrrosia nuda (Gies.) Ching in Bull. Chin. Brit. Soc. 1: 70. 1935; Baishya & Rao, Fern & Fern Allies of Meghalaya 76. 1982. *Niphobolus nuda* Gies. Farngatt. Niph. 149. 1901. *Cyclophorus nudus* C. Chr. Ind. Fil. 200. 1905. *Polypodium adnascens* Clarke Trans.

Linn. Soc. II. Bot. 1: 552. 1880 (Partim). *Niphobolus adnascens* Bedd. Handb. Fern. Brit. Ind. 325. 1883 (Partim).

Epiphytes. Rhizome slender about 2 mm thick, long creeping, compactly covered by scales. Scales pale brown, lanceolate about 4 mm long with deep brown, peltate base, edges ciliate. Stipes about 1-4 cm. sparsely stellate scaly and glabrous with age. Fronds uniform linear-lanceolate, 10-20 × 1-2 cm, hairy with adpressed stellate hairs, thinly fleshy midrib raised. Veins obscure. Sori depressed towards the upper half of the frond, leaving the tips. Sporangia oval, short stalked. Spores round, dark brown, irregularly grooved.

Ching (1935) reported its occurrence from Burma, Sikkim and Assam. This is the first report of its occurrence from South India.

This may be mistaken for *Pyrrosia lanceolata* (L.) Farwell. Material examined was very limited. In view of this a thorough study of these species is called for.

This is seen on tree trunks in the crevices of moist bark in dense forest but rare.

Specimens examined: KERALA: Cannanore Dt., Chandanthode, ± 840 m, 13.7.1978, *V. S. Ramachandran* 57676.

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SOUTHERN CIRCLE,
COIMBATORE-641 003,
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39. ADDITIONS TO THE ALPINE FLORA OF TUNGNATH

Tungnath area was previously explored during the years 1977-1978 and a total number of 280 species of flowering plants belonging to 157 genera and 50 families were recorded (Semwal and Gaur 1981). The area was further extensively explored and 53 species of angiosperms have been added to the previous list. The species are arranged according to Bentham and Hooker's system of classification. Specimens were identified in the Herbarium of Botanical Survey of India, Northern Circle, Dehra Dun (BSD) and the voucher specimens are deposited in the Herbarium of Garhwal University (GUH), Srinagar with Collector's name (J. K. Semwal) and field number.

ENUMERATION

RANUNCULACEAE

Aconitum violaceum Jacq. ex Stapf

Erect or decumbent herb with blue flowers. Khamdir, 4400 m. Sept. 1981 (1468).

Anemone tetrasepala Royle

Perennial herbs with white flowers. Chakdhar, 3400 m. July 1979 (1469).

Ranunculus diffusus DC.

Perennial herb with yellow flowers. Tungnath, 3600 m. June 1979 (1419).

R. tricuspis Maxim.

Delicate herb in crevices with small yellow flowers. Khamdir, 4300 m. Sept. 1981 (1420).

Thalictrum reniforme Wall.

Tall erect herb in fruiting. Daun, 3400 m. Aug. 1979 (1472).

T. minus L.

Erect herbs with purplish flowers. Tungnath, 3600 m. Aug. 1979 (1473).

PODOPHYLLACEAE

Podophyllum hexandrum Wall. ex Royle

A rare herb with green glaucous leaves. Deodarshini, 3400 m. June, 1980 (1474).

FUMARIACEAE

Corydalis cornuta Royle

Large straggling herb with yellow flowers. Above Chopta, 3350 m. Aug. 1980 (1421).

BRASSICACEAE

Megacarpaea polyandra Benth.

Robust herb with white flowers. Kilpor, 3500 m. July, 1980 (1461).

CARYOPHYLLACEAE

Lychnis fimbriata Wall. ex Benth.

Perennial viscidly-glandular herbs with fringed purplish-white petals. Tungnath, 3600 m. Aug. 1980 (1422).

Pseudostellaria cashmiriana Schaeftlein

Small perennial herbs with bulbous roots and apetalous flowers. Tungnath, 3500 m. July 1980 (1429).

ACERACEAE

Acer caesium Wall. ex Brandis

Large deciduous trees with palmately 5-lobed leaves and winged fruits. Chakdhar, 3300 m. June 1980 (1424).

FABACEAE

Astragalus chlorostachys Lindl.

Tall erect herbs with yellow flowers. Kilpor, 3400 m. July 1980 (1425).

Vicia pallida Turez.

Trailing herbs with violet flowers. Zabrya, 3400 m. June 1979 (1451).

ROSACEAE

Potentilla microphylla D. Don var. *commutata* Hook f.

Prostrate herb with yellow flowers. Konlyar, 4200 m. Sept. 1980 (1465).

P. ornithopoda Tausch

Silky herb with yellow flowers. Tungnath, 3600 m. July 1980 (1457).

Poterium diandrum Wall.

Erect herbs in fruiting. Konlyar, 4000 m. Sept. 1980 (1464).

Pronus cornuta (Wall. ex Royle) Carr.

Large deciduous tree with white flowers arranged in racemes and purplish-black fruits. Deodarshini, 3400 m. June 1979 (2896).

Rosa macrophylla Lindl.

Prickly shrubs with pink flowers and red fruits. Tungnath, 3450 m. June 1979 (2897).

Sibbaldia purpurea (Royle) Hook. f.

Perennials with decumbent stem and pink flowers. Konlyar, 4200 m. Sept. 1980 (2898).

CRASSULACEAE

Tillaea pharnaceoides Hochst. ex Steud.

Small herb with globose capsule, usually growing in moist localities. Tungnath, 3600 m. Sept. 1980 (1466).

ONAGRACEAE

Epilobium laetum Wall. ex Hausskn.

Erect herbs with angular stems and pink flowers. Tungnath, 3600 m. July 1980 (2899).

CAPRIFOLIACEAE

Lonicera obovata Royle ex Hook. f. et Thoms.

Decumbent shrubs with white flowers and blue-black berries. Tungnath, 3500 m. July 1980 (2900).

RUBIACEAE

Galium acutum Edgew.

Prostrate herb with minute whitish flowers. Specimens turn black after pressing. Konlyar, 4000 m. Aug. 1980 (1408).

ASTERACEAE

Dubyaea hispida (D. Don) DC.

Erect hispid herbs with fusiform roots and yellow heads. Khamdir, 3900 m. Sept. 1980 (1428).

Prenanthes brunoniana Wall. ex Hook. f.

Erect hispid perennial herbs with purple heads. Zabrya, 3400 m. Aug. 1980 (1429).

Ligularia sibirica (L.f.) Cass.

Tall herbs with yellow heads in terminal drooping racemes. Chakdhar, 3350 m. Aug. 1979 (1452).

Saussurea gossypiphora D. Don

Perennial wooly herbs with cylindrical heads which are purple or bluish-purple and concealed in the wool. Khamdir, 4600-5000 m. Sept. 1980 (1430).

CAMPANULACEAE

Campanula cashmiriana Royle

Herb with blue bell-shaped flowers. Tungnath, 3500 m. Aug. 1980 (1459).

Codonopsis rotundifolia Benth.

Hairy climber with purple veined flowers. Chakdhar, 3450 m. Aug. 1980 (1460).

ERICACEAE

Gaultheria nummularioides D. Don.

Decumbent undershrubs with greenish-pink corolla and dark purple fruits. Tungnath, 3500 m. July 1979 (1431).

PRIMULACEAE

Androsace lanuginosa Wall. ex Roxb.

Perennial hairy herbs on rocky slopes with pink-purple flowers. Rawanshila, 3400 m. Aug. 1979 (1432).

Primula nivalis Pall. var. *moorcroftiana* (Wall.) Pax.

Densely mealy herb. Fruiting. Khamdir, 4200 m. Sept. 1980 (1453).

P. stuartii Wall.

Robust herb with yellow flowers. Konlyar, 4000 m. Aug. 1980 (1454).

OLEACEAE

Jasminum humile L.

Deciduous glabrous shrubs with yellow flowers. Above Chopta, 3300 m. July 1979 (1433).

GENTIANACEAE

Gentiana albicalyx Burkill

Stemless herbs with leathery leaves and sessile white flowers. Tungnath, 3600 m. April 1979 (2815).

G. harwanensis Gurcharan Singh

Small erect herb on grassy slopes. Khamdir, 3800-4000 m. Sept. 1980 (1455).

G. pedicellata (D. Don) Wall. ex Griseb.

Erect or decumbent herbs with blue flowers. Rawanshila, 3400 m. April 1979 (1434).

G. tubiflora Wall. ex Griseb.

Perennial herbs with very much reduced stems and solitary terminal blue flowers upto 2.5 cm long. Konlyar, 4200 m. Sept. 1980 (1435).

Halenia elliptica D. Don

Erect glabrous herbs with light blue corolla prolonged into spurs. Deodarshini, 3400 m. Aug. 1980 (1436).

BORAGINACEAE

Mertensia racemosa (Benth. ex Royle) Clarke

Glabrous herbs in crevices with white flowers. Above Chopta, 3350 m. April 1979 (1437).

Myosotis sylvatica Hoffm.

Hairy herb with blue flowers in racemes. Kilpor, 3450 m. Aug. 1979 (1457).

SCROPHULARIACEAE

Pedicularis pectinata Wall. ex Benth.

Perennial glabrascent herbs with pink spikate flowers. Tungnath, 3600 m. Aug. 1979 (1438).

P. rhinanthoides Schr. ssp. *labellata* (Jacq.) Prain

Herb with deep purple flowers. Tungnath, 3600 m. Aug. 1979 (1462).

Scrophularia himalensis Royle ex Benth.

Erect perennial glandular herbs with greenish flowers. Zabrya, 3400 m. July 1979 (1439).

LAMIACEAE

Ajuga brachystemon Maxim.

Herbs forming basal rosette of leaves and whitish flowers. Above Chopta, 3350 m. May 1980 (1458).

POLYGONACEAE

Polygonum glaciale Hook. f.

Annual herbs with light pink flowers. Tungnath, 3600 m. Aug. 1980 (1463).

URTICACEAE

Elatostema surculosum Wt.

Sub-erect herbs, usually epiphytic. Above Chopta 3300 m. Aug. 1980 (1466).

FAGACEAE

Quercus semicarpifolia Sm.

Large evergreen trees with viviparous acorns. Above Chopta, 3350 m. July 1979 (1441).

SALICACEAE

Salix elegans Wall. ex Anderss.

Deciduous shrubs with minute seeds embedded in the white wooly hairs. Southern face of Chandrashila, 2750 mm. May 1979 (1442).

CYPERACEAE

Carex setosa Boott

Sedge in moist meadows. Tungnath, 3500 m. July 1979 (1475).

Kobresia nepalensis (Nees) Kukenthal

Sedge on rocky slopes. Tungnath, 3500 m. Aug. 1980 (1477).

POACEAE

Arundinaria spathiflora Trin

Bamboo upto 6 m high, in dense clumps on rocky slopes. Kilpor, 3450 m. June 1979 (1476).

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[1] Expired in April 1984.

40. NEW DISTRIBUTIONAL RECORDS OF SOME MANGROVE SPECIES FROM ORISSA COAST

Since the publication of Botany of Bihar and Orissa by H. H. Haines in the year 1922, many new plant species as well as new records have been discovered by various workers (Mooney 1950, Patnaik *et al.* 1956, Panigrahi *et al.* 1964, Saxena & Brahman 1978, Rao *et al.* 1967). During the studies on vegetation and flora of the Mahanadi delta in Cuttack district, Orissa state, I collected several mangrove species from Bhitar Kanika, Gahirimata, Thakurdian and False point estuarine islands of which eight species were found to be new distributional records.

MALVACEAE

Thespesia populneoides (Roxb.) Kostel. Allg. Med. Pharm. Fl. 5: 1836.

Trees 5-8 m tall with yellow flowers and partly dehiscent capsules, frequent along muddy sea shores and estuarine islands. Fruiting specimens of this tree are distinguished in the field by separation of exocarp from the endocarp at maturity. Orissa: Hookitola island, *L. K. Banerjee* 9517.

MILIACEAE

Aglaia cucullata (Roxb.) Pellegrin in Not. Syst. 1: 284. 1909.

Small tree with peg-like pneumatophores and cup-shaped terminal leafflets like *Ficus krishnae*, frequent along the banks of tidal creeks towards fresh water regions, usually in association with *Brownlowia tresa* and *Heritiera fomes.*

Orissa: Bhitar Kanika, *L. K. Banerjee* 9537.

PAPILIONACEAE

Intsia bijuga (Colebr.) O. Kuntze, Rev. Gen. Pl. 192. 1891.

Tree with 2-3 jugate leaves and purple flowers, frequent along fresh water mangrove swamps in association with *Heritiera fomes.*

Orissa: Bhitar Kanika, *L. K. Banerjee* 10231.

RHIZOPHORACEAE

Rhizophora stylosa Griff. Not. Pl. As. 4: 665. 1854.

Trees 5-8 m tall with many stilt roots. Leaves ovate-elliptic, obtuse at apex, cuneate at base; flowers white, arranged in dichotomously branched cymes; peduncles 4 times forked; petals villose; style 4-5 mm long. Hypocotyle cylindrical. Rare along the sandy sea shore, directly facing the sea surf.

R. stylosa is closely related to *R. mucronata* and *R. apiculata* already known from the area but can be distinguished by the presence of densely hairy petals and longer styles.

This species is so far known from Java, New Guinea, Philippines and North Australia, The present extension of its distribution along Orissa coast is a new distributional record for India.

Orissa: Thakurdian island, *L. K. Banerjee* 10232.

Ceriops tagal (Perr.) C. B. Rob. in Phil. J. Bot. 3: 306. 1908.

Small trees with fluted buttresses and stilt roots, sporadic towards inner mangrove fringes, usually in association with *Ceriops decandra* and *Bruguiera cylindrica.* Flowering specimen of the tree is distinguished in the field by the presence of 3 clavate appendages at the petal apex.

Orissa: Thakurdian island, *L. K. Banerjee* 10217.

SONNERATIACEAE

Sonneratia griffithii Kurz, in J. As. Soc. Beng. 40(2): 56. 1871.

Trees 10-15 m tall with many pneumatophores; leaves obovate, entire emarginate at apex, tappering towards base; flowers apetalous, white, solitary, axillary; fruits ovoid, flat at base. Frequent along the estuarine banks under the influence of high salinity and tidal innundation, usually in association with *Avicennia alba* and *Bruguiera parviflora.*

Distribution of this species has been reported from Andamans, Pegu and Tenasserim in Burma. The present occurrence of this species from Orissa is the first record for main land.

Orissa: Gahirimata island, *L. K. Banerjee* 9471.

APOCYNACEAE

Cerbera manghas Linn. Sp. Pl. 208. 1753.

Glabrous tree with yellow white flowers (turns purple) and woody fibrous fruits, common along the intertidal regions towards fresh water swamps in association with *Heritiera fomes.*

Haines though he did not collect this plant from the Mahanadi delta, made a mention of this plant in The Bot. Bih. and Orissa 1922 as follows" .... wild in Sunderbans and Chittagong and possibly occurring in the Mahanadi delta."

Orissa: Bhitar Kanika, *L. K. Banerjee* 10171.

AVICENNIACEAE

Avicennia marina (Forsk.) Vierh. var. **acutissima** Stapf & Moldenke in Phytologia 1: 411, 1940.

Bushy shrubs with elliptic acuminate leaves and yellow flowers, common along the Barua river mouth under high salinity conditions. Vegetative specimen of this shrub is distinguished from the typical variety in the field by its short petiols and acuminate leaf apex. This variety has so far been known from the West coast. Present occurrence along the East coast is of distributional significance.

Orissa: Barua river mouth, *L. K. Banerjee* 10279.

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41. SOME OBSERVATIONS ON THREE LITTLE KNOWN SPECIES ENDEMIC TO BHUTAN AND NORTHEAST INDIA

During field studies on the flora of Jalpaiguri District in West Bengal, in 1975-76, I collected three rare endemic species from the hilly tracts in the north-eastern part of the district, from the Buxaduar and Jainti forest ranges.

Ardisia bhotanica (Myrsinaceae) was described by C. B. Clarke in 1882, based on a single collection of William Griffith from Bhutan in 1838. The species appears to have eluded plant explorers from that time onwards for almost 138 years. Then on May 16th, 1976, I came across this plant growing in moist, cool and shaded situations in the semi-evergreen forests on the upper hills of Buxaduar forest range at about 1700 m elevation. It was found growing abundantly in association with *Ardisia undulata* Clarke, *Begonia laciniata* Roxb. and *Polygonum chinense* L., but was restricted to a very small patch of land about 3 sq. m. in area only *A. bhotanica* is an undershrub, 1-1.75 m tall, which is characterised by its lanceolate, crenate membranous and gland-dotted leaves and rosy-white flowers borne in simple panicles on decurved peduncles. I reported it from India as a new record (Sikdar 1979) and provided a detailed description and illustration for it.

All the relevant literature pertaining to Griffith's (1839, 1848) collections and travels in Bhutan were examined carefully and it is quite evident that the type locality Murichom is just north of Buxaduar. I also collected the plant in the Buxaduar forest range practically on the Indo-Bhutanese border. So, after a span of nearly one and a half centuries, *A. bhotanica* has been collected very near the type locality, and it may so happen that the two localities may be within a stone's throw of each other.

Even though quite a number of explorations, some of them extensive, have been conducted in Bhutan and neighbouring regions (13 by British between 1914 and 1975, 14 by Indians between 1963 and 1965 and 9 by Japanese between 1952 and 1970 and in the Buxaduar areas by K. P. Biswas in February-March 1934 and V. Narayanaswami and party in May-June 1949) none of them have collected and reported *A. bhotanica* so far. The species is presumably extremely localised and rare and thrives in a specific restricted ecological niche where alone all conditions favourable for its growth are found.

From the above studies it is concluded that *A. bhotanica*, now known as *Amblyanthopsis bhotanica* (Clarke) Mez, is a rare and endemic species confined to small patches and is adjacent to a mule track which was not a main thoroughfare in 1976 leading from Buxaduar past this locality towards the Bhutan border. At present, there is a major development programme called Chukha Project Authority, in Bhutan, which is hardly a day's march from Murichom northwards (mentioned by Griffith). The Chukha Hydel Project is already comming up. This project would necessarily involve road constructions, clearing of forests, etc. up to the project site which are factors quite likely to disturb the natural vegetation and ecological balance of the region. Hence any upset of the existing conditions is likely to threaten its very existence and it is very much in danger of becoming extinct.

It is significant to note that the only two gatherings of the species were in flowering conditions and the fruits (berries) of the species are not known till today.

Senecio bhot (Compositae) was described by C. B. Clarke in 1876, also based on a single collection of G. Griffith from Bhutan in 1837-38. It was collected again after a long gap of nearly a century, in 1912, by R. Lister, also from Bhutan. However, the precise localities for both the collections were not indicated. It has also not been possible to trace out the locality of Griffith's collections from literature. *S. bhot* was collected for the third time after another half a century, in 1964, by D. B. Deb from lower central Bhutan, enroute from Rani Camp to Tama, between 1650 m and 1350 m. Subsequently, there does not appear to be any further record of *S. bhot* from Bhutan or elsewhere till 1975.

In November 1975, I found this species growing in three separate localities in the hilly tracts of two adjacent forest ranges of Jalpaiguri district, namely, Jainti and Buxaduar, between 950 m and 1400 m. This is also the tropical semi-evergreen sub Himalayan foot hills region and is commonly known as the Duars. *S. bhot* occurred here sporadically along the open rocky forest paths and it also formed isolated patches on the hill slopes. The occurrence of the species in these two forest ranges covered an area approximately 10 kms long and 8 km wide. The presence of *S. bhot* in India was duly reported (Sikdar & Ghosh 1978) and it was accompanied by a detailed description and illustration. *S. bhot* is a herb or an undershrub, upto 1 m or more in height. It is characterised by its angled and ribbed stems covered with loose cottony hairs, sessile serrated leaves and showy yellow flower heads.

That *S. bhot* is a rare species cannot be denied. It is also endemic and confined to Bhutan and the Duars adjacent to it.

J. D. Hooker, in 1882, described **Aganosma gracilis** (Apocynaceae) based on two collections, namely, his own collection in *c.* 1830 from Sikkim Himalayas (2000-4000 ft) and that of Lobb in *c.* 1850 from Khasi hills (1000-

3000 ft). In the Central National Herbarium (CAL), there are only 5 subsequent collections of *A. gracilis.* Three are from Sikkim, collected by T. Thomson in 1857, T. Anderson in 1867 and G. King's collector in 1885. The fourth is Simons collection from Assam. Simons had been collecting in Assam valley approximately between 1830 and 1850 (cf. Burkill 1965). None of the above specimens indicated actual localities. The fifth specimen is collected from 'Rishi river' at 2500 ft. altitude, but collectors name and number have not been indicated. It has not been possible to ascertain the location of this river or to identify the collector.

Apart from Hooker, only Cowan & Cowan (1929) and Kanjilal *et al.* (1939) have reported *A. gracilis* from northern Bengal and Khasi hills respectively. Cowan & Cowan stated that it was found in the lower hill forests upto 5000 ft. in northern Bengal, without citing any specimen. Though J. M. Cowan had collected in India and Burma between 1919 and 1924 (Index Herbarium, 1954) and in north Bengal, it is not clear whether *A. gracilis* was actually collected by him or it was reported on the strength of Hooker's collection from Sikkim. Botanists then, usually considered Darjeeling and Kalimpong districts of Bengal as parts of Sikkim and this has also been stated by Cowan & Cowan in the introduction to their book. Since Cowan's collections are scattered in different foreign herbaria, it has not been possible to ascertain whether he collected the plant at all.

Kanjilal *et al.*, while recording *A. gracilis* from Khasi hills, stated that there were no specimens of *A. gracilis* in the Assam Forest herbarium and they must have included it in their flora on the basis of Lobb's collection from that area.

On May 14th, 1976, I came across a few plants of *A. gracilis* growing on hill slope at *c.* 1600 m, on way to Chunabhati of Buxaduar forest range. Though the species has been described as an evergreen climber, the plants here were probably in juvenile condition yet to acquire the climbing habit or perhaps unable to do so due to lack of suitable trees nearby or due to other factors. The plants bore beautiful white flowers, with long linear sepals, obliquely oblanceolate corolla lobes twisting to the right, borne in terminal corymbose cymes, with slender stems and branches and membranous leaves partially folded along the midrib near the tips. It had not been found anywhere else in this region in earlier or subsequent visits. This locality is in the same region as mentioned for the earlier two species.

A. gracilis is now known to be an endemic species confined to Sikkim, north Bengal, Assam and Meghalaya (Khasi hills) in the tropical and sub-tropical zone from the plains up to nearly 1600 m. It is represented by very scanty collections made mostly in the previous century even though some states like Sikkim have been explored many times. If we accept that Cowan collected the plant, then his collection had been made thirty five years after the previous collection by King's collector. I collected *A. gracilis* nearly fifty years after Cowan's report.

Unless the forests are retained in their present form many more rare elements like these, mentioned now, are likely to disappear with the forests. The Chuka Project Authority north of Buxaduar forest range and similar other development projects simultaneously with road constructions in the project sites, deforestation resulting in landslides, etc. are factors threatening the biospheres today. It is suggested that the hilly tracts of Buxaduar forest division, comprising of Buxaduar and

Jainti forest ranges, which are still comparatively rich in flora, semi-evergreen by nature, be declared as a Nature or Biosphere Reserve. The only redeeming feature is that Buxa forest has been selected by the W. Bengal Govt. for its second Tiger Project, covering an area of 600 sq. km. This project is awaiting approval and sanction of funds from the Centre. However, it is not known whether this area includes the hilly tracts in the northern part of Buxa division or the plains area in the south.

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42. ORCHIDS NEWLY DISCOVERED AND ADDED TO THE ORCHIDACEAE FROM INDIA

India having multivaried plant habitats including those of climatic extremes and having frontiers with countries like Pakistan, China, Nepal and Burma on the Himalayan range has been a continual and potential source of new plant species. Orchidaceae being rated as the largest flowering plant family in India and because of systematic plant exploration programmes during the past few decades has many new species added to its tally since the last 25 years. These new species have been reported in different journals and for facility in the general review of the whole family they are compiled and enumerated in the following list with their respective localities.

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Bulbophyllum brachypodum Rao et Balakr. var. *geei* Rao et Balakr. in Bull. Bot. Surv. Ind. 10: 350, 1968. Assam, Arunachal Pr.

B. leopardinum Lindl. var. *tuberculatum* Balakr. et Chowdh. in Bull. Bot. Surv. Ind. 9: 90, 1968. Assam.

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43. FAMILY LEMNACEAE IN THE KASHMIR HIMALAYAS

Lemnaceae, a simple and small family with about 4 genera and 40 species, is cosmopolitan in distribution. It is represented by 3 genera and about 7 species in our area, all aquatic, with extreme modification and reduction in the vegetative thallus. All the species are flowerless throughout their life span, reproducing vigorously by vegetative plates in this area.

Duckweeds as they are also called, are relished as food by herbivorous fish, ducks, geese, swans and other wild fowl. These are collected in large quantities and used as manure or fodder for cattle and pigs. The protein content is rich in amino acids and is regarded as poor peoples food (NAS, 1976). *Wolffia arrhiza* has been used as a vegetable by Burmese, Laotians and the people of Northern Thailand. In Kashmir all the species are fed to cattle and used as chiken feed after semi drying.

Key to the genera

1. Roots present: thallus disc shaped
    2. Roots more than one, in a fascicle.................................... *Spirodela*
    2. Roots never more than one .... *Lemna*
1. Roots absent, thallus spherical .... *Wolffia*

SPIRODELA Schleid, Linnaea 13. 391 (1839).

A genus of about 3 species, cosmopolitan, represented by a single species in our area.

Spirodela polyrrhiza (L.) Schleid. In Linnaea 13; 392 (1839); Hegalmair, in Bot. Jb. 21; 284 (1895). *Lemna polyrrhiza* L. Sp. Pl. 970 (1753): Hook. f. Fl. Brit. Ind. 6. 557 (1893).

Easily identified in the field as it is densely matted, free floating 2-6 fronds united, rarely solitary, each frond ovate or rounded, 4-6 mm dia., entire with 4-6 nerves, dark green flat above, reddish or purplish below. Roots 7-10 arising from the lower surface of each frond, hyaline, root caps 1-1.5 cm long. Locally called *Viout Mangoola,* never flowers in our area. They over winter by producing buds that are dense and sink to the bottom.

Common in lakes, ponds, streams, near marshes and other water sources; Bemna, A. M. Kak 3691: Habak, A. M. Kak 3879: Bouleward, A. M. Kak 3807.

Distribution: Kashmir (India), Asia, Africa, Australia, Europe.

LEMNA L. Sp. Pl. 970 (1753).

A genus with about 15 species. Cosmopolitan. In our area it is represented by the following 3 species (identification of the species is more certain on the fresh material).

Key to the species

1. Thallus elliptic or oblong, submerged, stipitate .... *L. trisulca*
1. Thallus oblong or elliptic oblong, free floating not stipitate
    2. Ventral surface of the thallus flat or slightly convex never inflatted .... *L. minor*
    2. Ventral surface of the thallus convex, ventrally inflatted .... *L. gibba*

Lemna trisulca L. Sp. Pl. 970 (1753): Hook. Fl. Brit. Ind. 6: 557 (1893).

The species can easily be identified in the field on the basis of the continuous chain like mats on or just below the surface of water, daughter colonies often remain attached to long attenuate stipes. Thallus elliptic, lanceolate or oblanceolate, flat both sides, translucent, greenish yellow, margins slightly wavy or entire, serrate towards apex. Each thallus with or without single root; root caps acutely pointed. Locally called as *Mangoola* it is present in sluggish streams, quiet lakes and ponds. Not much common as other duck weeds; Leper hospital (Nagin lake) A. M. Kak, 3736; Bemna, A. M. Kak 3906; Boulevard, A. M. Kak 3815.

Distribution: Kashmir (India), Asia, N. America, N. Africa, Australia and Europe.

Lemna gibba L. Sp. Pl. 970 (1753): Hook. l.c. 556.

The species can readily be distinguished in the field by being free floating, solitary or colonial (3-6) plants, oval convex, smooth, greenish yellow from the dorsal surface and globular, inflatted hollow, gibbous from the lower surface. Roots singly; root caps blunt. Common in lakes, streams, ponds also in permanent water reservoirs Bemna, A. M. Kak, 3881. Shalten, A. M. Kak, 3816; Mirgund Rukh, A. M. Kak 3905.

Distribution: Cosmopolitan.

Lemna minor L. Sp. Pl. 970 (1753): Hook. f. l.c. 556.

Very common plant, occurs in association with other duck weeds. Fronds in colonies of 3-5, rarely solitary, obovate oblong yellowish green or dark green above, slightly convex ventrally with a single root. Everywhere in ponds, ditches, near artificial water reservoirs, also in the lakes. Shalteng., A. M. Kak 3880; Habak, A. M. Kak, 3814, Nandpora (Nagin) A. M. Kak 3905.

Distribution: Cosmopolitan.

WOLFFIA Horkel ex schleid, in Linnaea 13: 389 (1839)

A genus of about 10 species mainly of Tropical and Sub-tropical regions of the world. It is represented by 3 species in our area all aquatic. The members of the *Wolffia* do not produce flowers in our area, and the propagation is purely vegetative. Thallus sometimes bearing masses of red pigment bodies in the epidermal cells.

KEY TO THE SPECIES

1. Thallus more or less globular, loosely cellular, without any papilla
    2. Upper surface round, flat, fronds floating on the surface of water .... *W. arrhiza*
    2. Upper surface slightly convex, rarely flat, ellipsoid fronds floating just below the surface of water .... *W. columbiana*
1. Thallus broadly ovoid with a prominant, compactly cellular conical papilla in the centre of dorsal surface .... *W. papulifera*

Wolffia columbiana Karsten. Deutsch. Fl. Pharm. med. Bot. (1880); Fernald, Gray's Man. 336 (1949): Kak *et al.* Ind. Forest. 104: 4 (1978).

Vigorously multiplying by budding. The thallus is small, free floating, solitary or paired, ellipsoid rarely globular, upper flat portion touching the surface, green on all sides, not conspicously punctate.

Common in permanent stagnant water, rich in organic debris. Chandmari, Srinagar, Gagribal, near Dal gate, Srinagar in paludal stream. A. M. Kak, 3211, A. M. Kak, 3236.

Distribution: Europe, Tropical America, Himalayas; Kashmir.

Wolffia papulifera Thomps. Ann. Rept. Indiana Geol. Survey. 17: 171-191 (1892): Fernald, Grays. Man. 386 (1949): Kak, l.c. 104.

Floating or submerged annual herbs. Thallus simple or paired, broadly ovoid, green conspicously punctate on all sides; dorsal surface flat bearing an outgrowth like papilla in the mid of the thallus. vegetative growth not so vigorous and takes place by the detachment of tiny ovoid green plates.

Common in permanent stagnant waters, Gagribal; A. M. Kak 3940, near Dal gate (Srinagar) A. M. Kak, 3262, A. M. Kak 3275.

Distribution: Europe, America, Kashmir.

Wolffia arrhiza Wimm. Fl. Schler 140 (1857): Hook. f. Fl. Brit. Ind. 5: 557 (1893).

It can be easily identified in the field as it is the smallest duck weed, 1-1.5 mm dia., hemispherical, green. Roots and other reproductive organs absent.

Rarely present in the ponds, temporary water reservoirs, Rainawari A. M. Kak 3950; Nowpora (Khayam) A. M. Kak 3892.

Distribution: Cosmopolitan.

ACKNOWLEDGEMENTS

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ERRATUM

Volume 82(3): December 1985

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16. Use of wet dung in egg chamber of half built nest by the black throated weaver bird.

On page 661, in Table 1,

For Flowers only used.

Read Male flowers only used.

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August 1986 Vol. 83 No. 2

OBSERVATIONS ON PREDATORS AND PREY AT ERAVIKULAM NATIONAL PARK, KERALA[1]

CLIFFORD G. RICE[2]

(*With six text-figures*)

Antipredator strategies of Nilgiri tahr (*Hemitragus hylocrius*), sambar (*Cervus unicolor*), gaur (*Bos gaurus*), and Nilgiri langur (*Presbytis johni*) are described. Habitat use, hunting and killing methods, and prey selection are presented for tiger (*Panthera tigris*), leopard (*P. pardus*), Asiatic wild dog (*Cuon alpinus*), jackal (*Canis aureus*), and humans. Observations and evidence from droppings indicated that tiger, leopard, and wild dog all preyed most frequently on sambar. Leopard and wild dog also preyed on Nilgiri tahr. Observations from Eravikulam National Park are used as a basis for the discussion of some general concepts of antipredator behavior.

INTRODUCTION

The study of predator-prey interactions of large mammals in the Indian sub-continent has been hampered by the problems of making observations on animals in thick forests, shy subjects (both predators and prey), and the solitary and nocturnal habits of many of the predators. The open, rolling grassland of Eravikulam National Park provided opportunity for observing a diversity of predators and prey. Although the shyness of the predators remained a problem, the observations presented here give some further insight into relations between large predators and their prey in this region.

STUDY AREA

Eravikulam National Park is located in the High Range of the Western Ghats north of Munnar, Kerala. The area was previously part of the land of the Kanan Devan Hills Produce Corporation (now Tata Tea), but was declared a sanctuary in 1975, and upgraded to a national park in 1978.

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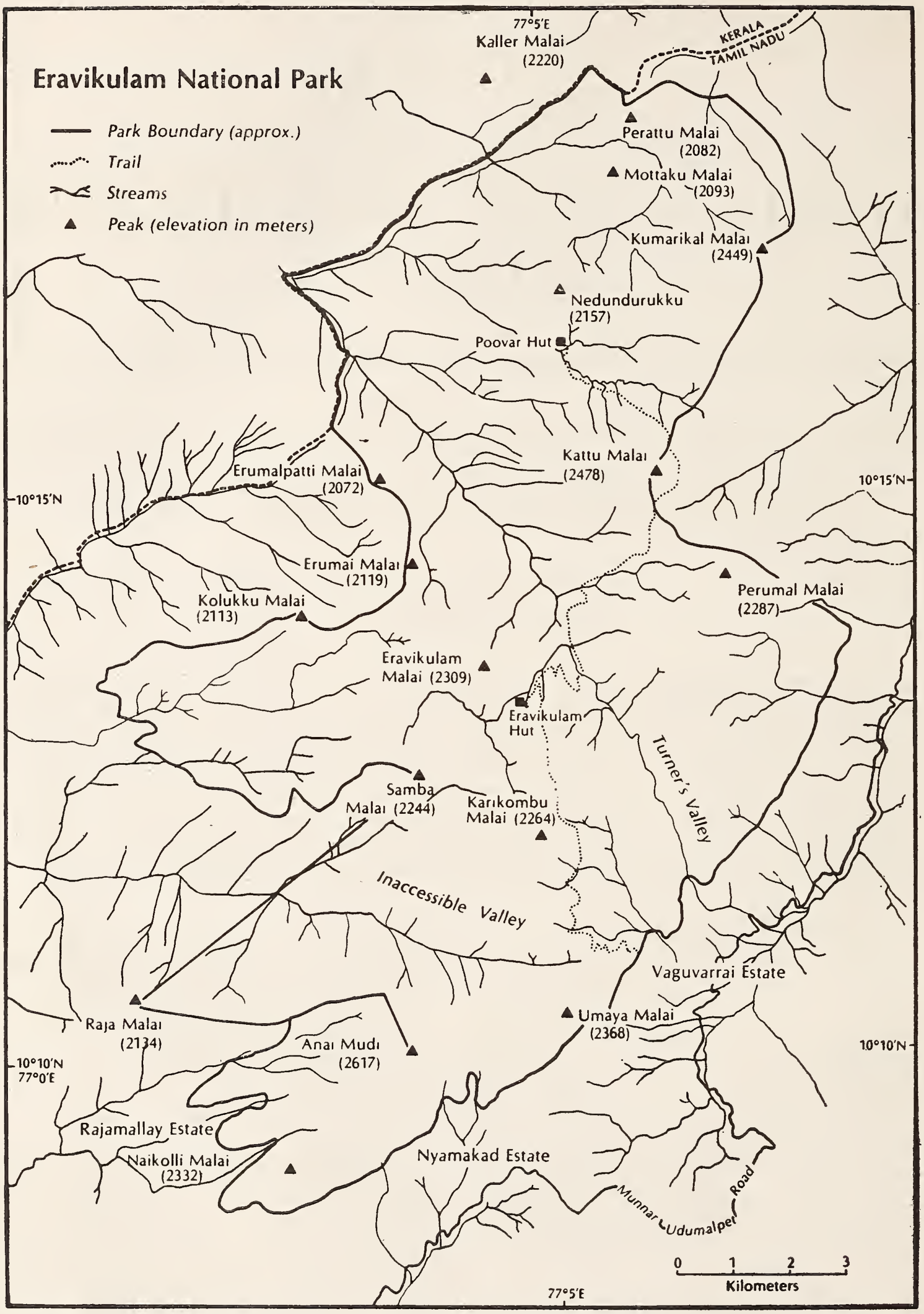
Eravikulam National Park
Park Boundary (approx.)
Trail
Streams
Peak (elevation in meters)
77°5'E
Kaller Malai (2220)
KERALA
TAMIL NADU
Perattu Malai (2082)
Mottaku Malai (2093)
Kumarikal Malai (2449)
Nedundurukku (2157)
Poovar Hut
Kattu Malai (2478)
10°15'N
10°15'N
Erumalpatti Malai (2072)
Erumai Malai (2119)
Kolukku Malai (2113)
Perumal Malai (2287)
Eravikulam Malai (2309)
Eravikulam Hut
Turner's Valley
Samba Malai (2244)
Karikombu Malai (2264)
Inaccessible Valley
Vaguvarrai Estate
Umaya Malai (2368)
Raja Malai (2134)
Anai Mudi (2617)
10°10'N
10°10'N 77°0'E
Rajamallay Estate
Naikolli Malai (2332)
Nyamakad Estate
Munnar Udumalpet Road
0 1 2 3
Kilometers
77°5'E

Fig. 1. Approximate boundary of Eravikulam National Park. From Rice 1984.

The main body of the park is comprised of a high rolling plateau, with a base elevation of about 2,000 m. The plateau is split roughly in half from northwest to southeast by Turner's Valley, which has a maximum depth (within the park) of about 600 m. Knolls and hills generally rise up to 500 m above the plateau, although Anai Mudi, the highest point in India south of the Himalayas, reaches 2,697 m. The fringes of the plateau are frequently precipitous, often with broken cliffs and steep slopes. However, the cliffs are usually not abrupt, but rounded both vertically and horizontally. For the most part, the park boundary is coincident with the edge of the plateau. The main physical and political features of Eravikulam National Park are shown in Fig. 1.

Three major types of plant communities are found within Eravikulam National Park; grassland, shrubland, and forest. As is typical for most of the Western Ghats, terrain over about 2,000 m is primarily covered by grassland, and there are numerous small patches of forest in hollows and gullies. The deeper valleys are extensively forested, while shrublands predominate along the bases of the cliffs and are interspersed in rocky slab areas. Patches of forest are locally known as sholas.

Large mammals found within the park are Nilgiri tahr (*Hemitragus hylocrius*), sambar (*Cervus unicolor*), gaur (*Bos gaurus*), barking deer (*Muntiacus muntjak*), Asiatic elephant (*Elephas maximus*), tiger (*Panthera tigris*), leopard (*P. pardus*), Asiatic wild dog (*Cuon alpinus*), jackal (*Canis aureus*), jungle cat (*Felis chaus*), stripe-necked mongoose (*Herpestes viticollis*), Nilgiri langur (*Presbytis johni*), and humans.

The annual weather cycle is dominated by the monsoon. Of the average annual rainfall total of 405 cm, about three-fourths falls during the monsoon months of June, July, and August. Sunshine is rare during the monsoon, and strong westerly winds, up to gale force, are the rule. At Eravikulam the post-monsoon (sometimes called the northeast monsoon) lasts from September through December. Rainfall is considerably diminished (about 25 cm/month), with moderate and variable winds. Mist commonly engulfs the hills during both the monsoon and post-monsoon. There is little rainfall during the winter (January and February), and the skies are usually clear. Winds are moderate to light, and mostly from the east. As the pre-monsoon proceeds (March through May), thundershowers become more and more frequent, while moderate easterly winds still predominate. For more detailed information on the history, physiography, plant ecology, and weather of Eravikulam, see Shetty and Vivekananthan 1971, Subramaniam and Nayar 1974, and Rice 1984.

METHODS

This report is based on observations made during a study on the behavior and ecology of Nilgiri tahr conducted from 8 August 1979 to 26 September 1981 (Rice 1984). During the second half of the study many observations were made on a habituated subpopulation of about 120 tahr. For the purposes of this report, Nilgiri tahr are divided into the following sex and age classes: young—less than one year old; yearling—one year old; female—female two years or older; light brown male—male two to three years old; large light brown male—male four years old; dark brown male—male five years old; and saddleback—male six years or older.

Observations on predators and other prey species in the park were made whenever opportunity presented itself. Indirect evidence was obtained from examining predator kills.

For recent kills, the predator involved could often be identified by examining the kill and the surrounding ground. For instance, the wild dog's propensity for killing sambar in the water usually left little doubt as to their involvement. Toothmarks or the manner in which the prey had been consumed were also important indicators. In other cases droppings or tracks in the vicinity implicated a certain predator. Predator droppings were also examined for prey remains.

PREY

Nilgiri tahr

About 550 Nilgiri tahr inhabit Eravikulam National Park, making it the largest wild population (Rice *in press*). The tahr generally inhabited the fringes of the grassy plateau, but also moved onto the steep slabs and cliffs bordering it. They occasionally visited the shrublands along the base of the cliffs. Tahr generally avoided sholas, but sometimes foraged along their periphery. Nilgiri tahr at Eravikulam occurred in large groups, numbering up to 150 individuals. Adult males separated from mixed groups outside the rut, and often ranged outside the areas used by the mixed groups (Rice 1984). Most tahr were born in January and February, but some births occurred early in the spring and during the monsoon.

The vision of Nilgiri tahr seemed to be about on par with my own, as they seemed to discern distant animals at about the same distance as I could. Their hearing too, seemed comparable to mine, although this was more difficult to gauge. The sense of smell of the tahr, on the other hand, was evidently quite good. One had to take the wind into account when approaching tahr, and once several tahr turned and oriented upwind as two men passed by on a trail out of sight a couple of hundred metres away.

The tahr's predilection for the plateau margins probably represents a compromise between the advantages of access to the better grazing in the grassland, and ready access to precipitous terrain. When disturbed in grassland, Nilgiri tahr generally moved directly towards the nearest set of cliffs, at a gallop if the danger was immediate, or more slowly if the threat was more remote. The tahr appeared to have an excellent mental map of the terrain they occupied, and took flight in the appropriate direction almost without fail. A notable exception was when a number of animals from another area joined a group of habituated tahr. Presumably because they were unfamiliar with the terrain, the new animals took flight directly away from me rather than onto the nearby cliffs. What happened once the tahr were on the rock slabs depended greatly on what predator was involved (see below). I never saw tahr take flight into a shola. When not running at full speed, alarmed tahr typically ran with a pronounced rocking horse-like gait, striking the ground forcefully with both fore and hind legs. An alert tahr stood in erect posture, with the neck raised above the normal posture. When on a slope, the tahr extended the neck laterally as well to obtain a better view along the slope (see photo in Schaller 1971).

All of the above reactions were effective in communicating a tahr's aroused state to other tahr. In addition, tahr performed distinctive displays which also served this function. The conspicuous sneeze-whistle is produced by expelling air forcefully through the nostrils, and has a sharp, high, thin, airy quality. Loud whistles could be heard up to 1 km away. The tahr involved generally whistled from a stationary alert posture, making it difficult to distinguish which individual was whistling if several animals were alert. Whistling evidently indicated a high level of arousal in a tahr, either from not being able to clearly identify an intruder, or upon observation of a predator at close proximity. The whistle was also sometimes given by an estrous female when closely and vigorously courted by males, which indicates that it signified anxiety or agitation rather than specifically alarm or fear.

The foreleg stamp was another indication of an agitated state in Nilgiri tahr. This was evidently both an auditory and visual signal, as the stamp could be heard by nearby animals, and the sudden movement contrasted conspicuously with the otherwise stationary alert posture. Nilgiri tahr did not raise their tails in this context.

I recorded the sequence and timing of whistling and stamping of one female located on the periphery of a group on 28 March 1980. At 1029 h she became alert and began whistling in response to an unidentified stimulus. Figure 2 shows the sequence of whistles and stamps starting four minutes later, and until she turned and moved away at 1103 h. In those 30 min she whistled a total of 79 times, stamped 43 times, and the stamp and whistle were simultaneous 26 times. Although stamps were less frequent than whistles, they both showed a similar pattern, suggesting that both increase with increasing excitement. In addition, the per cent of whistles accompanied by stamps was also closely correlated with the frequency of whistling and stamping.

The response of other tahr to these signals varied somewhat with the circumstances. Generally they oriented in the same direction as the alerted animal, and sometimes moved to gain the same viewpoint if they could not discern the cause. However, alarm of this type was only temporarily contagious, and tahr that did not confirm the need for alarm soon lost interest. This was evident when an unhabituated individual in a habituated group (such as a newly arrived male), became alarmed at my arrival. As soon as the habituated tahr ascertained that I was the stimulus for the arousal, they resumed their normal behavior. The lack of alarm in the habituated tahr also had a contagious effect on unhabituated tahr, and this served to habituate a new arrival almost completely within one week. Similarly, when the female whose alarm signals are depicted in Fig. 2 began her whistling, the whole group rose, and several tahr from the group above came down behind her. However, unable to discern the cause, they began grazing within 3 min, and many rested by 7 min after the onset. Then, as the female resumed frequent whistling at 19 min, some again rose, only to rest again at 25 min. The female turned and moved up to them at 30 min.

Further details of alarm behavior are given below in the descriptions of interactions with predators. Flight and defense also varied considerably between the predator species and will be described in that section.

Sambar

Unlike Nilgiri tahr, sambar are primarily an inhabitant of forests. However, they did come out onto the grassy slopes to graze, particularly in the early morning and late evening. Although I never saw them there, sign indicated that sambar used the extensive grass areas of the central plateau during the night. They also frequented the shrublands along the base of cliffs. Sambar were generally seen alone or in small groups of around a half a dozen. Occasionally they came together in groups of a dozen or more. At Eravikulam sambar gave

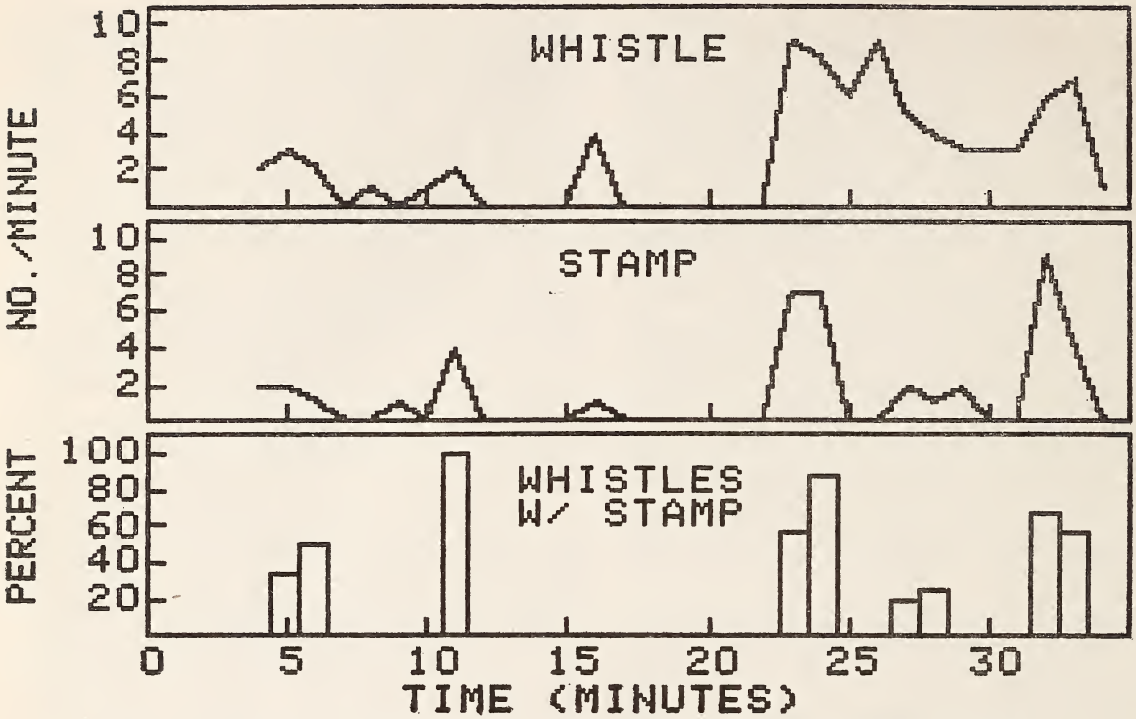

Fig. 2. Number of whistles and stamps per minute and percent whistles coinciding with stamps given by an adult female Nilgiri tahr in response to an unidentified disturbance. Starting time: 1129 h, 18 March 1980.

birth in the post-monsoon, indicating a rut during the pre-monsoon.

The vision of sambar seemed somewhat less acute than that of tahr, at least over long distances. Sambar are reputed to have an excellent sense of smell (Johnsingh 1983).

In direct contrast to tahr, sambar typically took flight into sholas when disturbed. Their alert posture was essentially the same as the tahr's. The sambar's alarm call is a loud, hoarse, brief vocalization (Schaller 1967, Johnsingh 1983), audible over long distances. Sambar called, sometimes repeatedly, in similar contexts as the tahr whistled.

Sambar also stamped a foreleg when agitated, but often kept the foreleg raised for a second or two before stamping. When agitated and in flight sambar raised their tails, exposing the light colored hairs under the tail. Further information on sambar's reaction to predators is given in the section on predators.

Gaur

Like sambar, the gaur is primarily a forest animal. Gaur, however, generally remained in the vicinity of sholas when grazing although they did occasionally move across extensive grasslands. They travelled in groups of up to about 30.

The vision of gaur is reputedly poor (Krishnan 1975, Prater 1980), and my experience suggested that this was true. Their sense of smell, however, is exceptionally good (Schaller 1967).

Gaur also took flight directly into sholas. Other than orienting (at least the head) toward the source of disturbance and flight, gaur showed no marked signs of agitation, although Schaller (1967) mentions snorting and "growling" and Wemmer (pers. comm.) noted a loud, hissing snort in this context.

Nilgiri langur

Nilgiri langur were often seen in the extensive valley forests, but also made their way to isolated sholas in the highlands. They rarely moved out of the trees to feed in the adjacent grassland. I was generally unable to count the number of animals, but most groups seemed to be of about a dozen.

An alert Nilgiri langur usually sat upright on a branch and oriented toward the disturbance. The typical response to evident danger was the gruff bark (Poirier 1970), a sharp, loud cough, a series of which often ended in a whoop. Although I never saw humans pursuing Nilgiri langur, they were reportedly sometimes killed as their flesh is reputed to be beneficial in treating respiratory ailments.

Other species

Muntjac and elephants were both seen a few times during the study. The muntjac rarely left the valley sholas, although I did hear their alarm call (Wiles & Weeks 1981) on occasion. Elephants passed through the area from time to time, usually crossing the plateau in the course of a night. I observed no interactions between predators and either of these two species.

TABLE 1

NUMBER OF OBSERVATIONS ON PREDATORS DURING THIS STUDY IN ERAVIKULAM NATIONAL PARK

		Leopard					
	Tiger	Black	Spotted	Both	Wild dog	Jackal	Human
Sign:							
Tracks	43	–	–	8	2	4	–
Scrape	2	–	–	9	–	–	–
Sightings:							
Total	10	6	3	10	18	24	8
In tahr home range	4	6	3	10	11	11	2
Apparently hunting:							
Tahr		2	2	4	8		2
Sambar	1	1		1	4		1
Attack:							
Tahr		1	2	3	7		1
	1				2		
Kill observed:							
Tahr			1	1	6		1
Sambar					1		
Kills attributed:							
Tahr				1	1		1
Sambar	1				13		
Gaur	1						

THE PREDATORS AND THEIR INTERACTIONS WITH PREY

A summary of observations on predator species made during the study is shown in Table 1. The number of sightings refers to the total number of times a species of predator was seen, regardless of the number of individuals involved. The number of interactions, on the other hand, reflects the number of interactions with any one prey, including multiple chases and kills. The occurrence of prey remains in predator droppings collected during the study is given in Table 2.

TABLE 2

PERCENT OCCURRENCE OF PREY REMAINS IN PREDATOR DROPPINGS COLLECTED DURING THIS STUDY FROM ERAVIKULAM NATIONAL PARK

	Tiger	Leopard	Asiatic Wild dog	Jackal
Gaur				1
Sambar	94	38	90	6
Nilgiri tahr		29	8	1
Barking deer	11	10	5	1
Nilgiri langur		27		
Porcupine		4		
Rodent		6		91
Bird				6
Lizard or Snake		6	3	31
Crab				1
Insect		4		10
No. of droppings	18	48	40	139

Tiger

Tiger are not numerous at Eravikulam National Park, as one might expect considering the elevation, rough terrain, and open habitat. In fact, all five of the tiger sightings in which I could see the facial markings were of the same female. These enclosed an area of 11 km^2. All of my sightings were of solitary tigers (Table 3), but Wildlife Preservation Officer M. Alambuth (pers. comm.) encountered a subadult tiger and tracks of an adult and subadult on the north side of Kattu Malai. Whether this was the same individual female is uncertain. I encountered tiger tracks much more frequently than those of other predators, on a total of 43 occasions (Table 1). This is probably more an indication of their propensity to travel man-made roads (Schaller 1967, Seidensticker 1976, Sunquist 1981), than it is an indication of their abundance or level of activity in the area. Tiger scrapes, on the other hand, were rarely encountered.

Of the 11 tiger sightings, only 4 were in tahr home range, and in none of these cases did the tiger appear to be hunting tahr. I observed tahr and tiger encounters three times, all apparently by coincidence. On 29 March 1981, a group of 27 tahr were climbing a ridge on the northeastern flank of Turner's Valley. At 1130 h a tiger casually crossed the west side of a knoll about 250 m ahead of them. Although the tiger did not seem to notice the tahr, they saw the tiger. They did not show a strong alarm reaction at that distance, but did cease their movement, and by 1200 h they had reversed their direction. On another occasion, however, the tahr showed more obvious arousal, including whistles, as they watched a tigress traverse the opposite slopes of a ravine, about 200 m away.

Another encounter occurred when a tiger climbed out of a ravine, surprising a group of tahr on a grassy ridge top during a rain shower on 19 June 1981. The first tahr to see the tiger, a female resting on the group's perimeter, jumped up and ran directly away from the tiger, and as the tiger came into full view, the entire group dashed off, and then kept moving, running and walking, until I

Table 3

Percent sightings of predators in each group size during this study, Eravikulam National Park (excludes sightings for which a total count was not possible)

Predator	Tiger	Leopard	Asiatic Wild dog	Jackal	Human
No./group 1	100	82	1	60	
2		18	2	40	5
3			3		7
4					9
5					23
6					14
7			7		16
8					
9			87		
10					
11					
12					27
No. animals sighted	11	11	103	30	44
No. of groups	11	10	14	24	8
Mean group size	1.0	1.1	7.4	1.2	5.5

found them 7 min later, standing about 150 m away, still some 75 m from the nearest cliffs. Although the tiger had moved right to this group, it made no attempt to conceal itself, either before being seen by the tahr, or afterwards, despite the availability of cover in the form of numerous *Strobilanthes* shrubs. The interaction, however, was interrupted prematurely when the tiger caught a glimpse of me, at which it turned and slipped back into the ravine from which it had come.

Sambar reacted strongly to a tiger in the open, but did not take flight in the one instance I observed. Rather, as the tiger passed 100 m below them, the sambar stood alert, calling and stamping. As the tiger moved on and out of sight, the sambar moved down and sniffed the grass along the trail.

A tiger was observed pursuing prey only once. The following account was taken from my field notes of 29 March 1981.

1618 h. Sambar start giving alarm calls from a large shola in Turner's Valley at the base of the west side of Poola Malai. A growl, apparently of a tiger, also is heard.

1624 h. Calling continues, at least 20 calls. Tahr grazing low on the opposite slopes move up into a small bowl in the grassland, apparently in response.

1639 h. The tiger is first seen bounding, then moving more slowly across the grassland flats at the base of the valley below the shola. It is following a sambar doe which is moving up the base of Turner's Valley, about 250 m ahead. The sambar doe has a wound on her right hind leg, a large chunk of tissue hanging free, although it does not appear bloody. She continues up the valley, and then turns uphill to enter another shola about 800 m from the first at 1645. The tiger also continues up the valley, swimming through one pool in the stream, and then climbs on to the flats. Walking at a steady pace without hesitating, the tiger follows roughly the same path as taken by the sambar, although it is not obvious if it is following visual or olfactory cues.

1650 h. The tiger also enters the second shola.

1658 h. A series of sambar alarm calls come from the shola. Then 10-20 more at intervals of a few seconds.

1659 h. Having emerged from the side of the shola, the tiger again appears moving down the side of the valley, rounds a grassy ridge, and trots back into the first shola.

1701 h. After passing through the top of the shola, the tiger comes out onto the burned grassland above it, 1702. It is apparently still on the trail of the sambar doe whose movement I seem to have missed from my distant vantage point. The doe is now with several other sambar on the grassy slopes above and ahead of the tiger. Her wound is roughly rectangular in shape, 30 cm down from the base of the tail, 8-10 cm high, and about 6 cm deep at the top and about 4 cm deep at the bottom margin. It has a clean-cut appearance when seen from the side, but tissues approximately equivalent to the displaced volume hang and flap along the inside of her thigh. There is no evidence of any other wounds.

1708 h. Having apparently lost track of the wounded doe, the tiger doubles back, retraces her steps and disappears into the top of the shola.

1716 h. The tiger moans several more times. The doe has continued across and up the slope, and moved from view.

1733 h. The tiger reappears at the top of the shola, sniffing the ground while moving. It climbs in switchbacks up the slope, now 50 m above. As the tiger comes into view the other sambar call. The tiger looks up at them and then doubles back up the valley as the sambar continue to stand and call, even after it moves out of sight.

1741 h. Tiger moans again. It is now just above the shola where it emerged earlier, apparently trying to relocate the wounded sambar's trail.

1750 h. The tiger starts up the slope again, galloping a few strides, then stands. It moves toward the other sambar, then turns back and forth.

1754 h. One of the sambar above sees the tiger and calls. The tiger zigzags around in the grassland, giving a moan. Now about 100 m apart and in plain view of each other the tiger and sambar stand facing each other. The sambar call, but not as persistently as earlier.

1802 h. The tiger seems to be searching the area for the wounded sambar's trail, moving back and forth.

1806 h. The tiger traverses the slope above the sambar and moves to the ridge, stands, and then sits on its haunches. . . .

1809 h. The tiger moves on around the corner out of sight.

1826 h. Sambar alarm calls alert me to the tiger traversing back across the slopes. The tiger moans. The sambar take flight at about 50 m.

1828 h. The tiger moans again, diagonalling down across the slope. Six more moans by 1834 h. I lose track of it in the fading light, but moans are still heard until 1856 h.

This would appear to be a rare instance of an extended pursuit by a tiger, much in contrast to the quick and efficient hunting and killing usually attributed to them. However, such a judgment is difficult to make in view of the scarcity of eye-witness accounts of interactions of tiger and wild prey. This scarcity is understandable considering the shyness of the animals and the thickness of the vegetation which they inhabit. Most accounts of killing are of tethered domestic buffalo baits, and are of little use for comparison here (Schaller 1967, McDougal 1977, Sunquist 1981). Nevertheless, it does illustrate that a tiger may pursue its prey for some distance, covering more than 2 km in over 2 h in this case. The wound was presumably inflicted at the initial attack, and was likely an important stimulus for the continuation of the pursuit.

The tiger was probably using its sense of smell when following the sambar doe up the floor of the valley, and certainly seemed to be searching for a scent trail when zig-zagging on the slopes above the shola. Likewise it does not seem likely that the tiger could have kept on the trail of the sambar through so much grassland and forest without being able to follow the scent trail. This indicates that, as Schaller (1967) has reasoned, that a tiger's sense of smell is fairly good.

I found one fresh sambar kill near a small lake in open grassland which I attributed to tiger. Hairs in tiger droppings gave another indication of the extent to which tiger prey on sambar (Table 2). This evidence supports the observational evidence that tiger do not prey on tahr, but depend primarily on sambar for sustenance. On the other hand, Davidar (1971) found tahr hair in two of the five tiger droppings he examined from the Grass Hills.

While Sunquist (1981) maintains that gaur are "virtually invulnerable" to tiger predation by virtue of their large size, this was not the case at Eravikulam. I found one gaur cow on the flats of the central plateau which had evidently been killed by a tiger. She bore numerous canine punctures on both the throat and nape, indicating numerous bites by the tiger, and a claw mark on the shoulder. Sunquist (1981) and McDougal (1977) agree that the nape bite is used by tiger for smaller kills, while the throat bite is used in killing larger animals (over about 90 kg). This tiger had quite obviously used both repeatedly on this very large prey (about 500 kg). Also, of the four tiger droppings I collected in the Grass Hills in 1978, an area where gaur seemed to be more plentiful, three contained gaur hair. Schaller (1967) and Johnsingh (1983) also reported gaur remains in tiger droppings from Kanha National Park and Bandipur Tiger Reserve, respectively.

Leopard

Both black and spotted phases of leopard occurred in Eravikulam National Park. Although the number of sightings of the black phase was more than twice that of the spotted (Table 1), these may be all of two individuals as they were all within a limited area of about 6 sq km. It is likely that these leopards ranged outside of the area in which I encountered them, and probably used an area similar in size to the 8-10 sq km estimated for leopards at Wilpattu National Park, Sri Lanka (Eisenberg and Lockhart 1972), or Chitwan National Park, Nepal (Seidensticker 1976). If this is the case, Eravikulam National Park could harbor upwards of 10 leopards, with others inhabiting adjacent forested areas. With the exception of one pair, all sightings were of single leopards (Table 3).

Leopard tracks were met with much less frequently than those of tiger, primarily because leopards used man-made trails much less frequently than tiger (see also Sunquist 1981). Most of the tracks I encountered were along a soft dirt game trail along the western rim of Turner's Valley. Leopards also frequently left scrapes in this area, which coincided with the southernmost limit of my observations of the black phase.

In marked contrast to tiger, all leopard sightings were within tahr home range, and they appeared to be hunting tahr on 4 of the 11 sightings. Tahr reacted strongly to the presence of a leopard, but nevertheless, tolerated and even maintained a close proximity to them as is illustrated by the following observations from my field notes:

> At 1410 h on 29 April 1980 the tahr I am observing alert me to the presence of a spotted leopard on a rock slab below the grassy slopes we are on. Several tahr cluster at the top edge of the slabs, standing alert and giving numerous whistles. The leopard, without any attempt at concealment, moves across towards the tahr, passing about 10 m below them. At the same time, the tahr at the edge of the slabs mill about, some individuals turning as if to run up the slope, only to turn about and return to the edge of the bluff. The leopard moves out of sight briefly, but the tahr's attention stays on it as it moves around

below. The leopard makes a sudden rush up through a break in the slabs and the tahr scatter as the leopard passes through the group, some turning uphill, others down onto the slabs, but all turn in a tight circle to face the leopard again. The leopard looks up, directly at me 25 m in front of it, sits for a moment, then drops to the ground and slips from view into a small gully at 1420 h.

On 22 May 1980 the tahr again draw my attention to a black leopard with a series of whistles. As I locate it on the slabs across the ravine they are turning to watch it at a distance of 10-15 m, with only rock slabs between them. The leopard runs through the group and past them and around the corner of a ridge. The tahr follow as the leopard moves from view, and cluster tightly at the corner of the ridge, whistling continually. Occasionally some turn and run from the edge, then turn about to join others. In this fashion the tahr "leap-frog" up the ridge, evidently as the leopard moves along the far side at 1220 h.

I move to a vantage point on the other side of the same ridge to find the leopard and tahr looking at each other about 8 m apart. The leopard walks toward some of the tahr, and they, in turn move from it, whistling continually and giving an occasional stamp. At 1303 h the leopard lies down on a grassy ledge, looking at about 15 tahr clustered above, looking back at it. Tahr whistling continues. The leopard rests its head on the grass at 1306 h, then raises and waves its tail, and rises at 1313 h. Tahr renew their whistling. The leopard moves forward and the tahr scatter, keeping about 6 m from it as it moves from view.

Part of the leopard is visible as it rests again, 1317 h. Tahr relax somewhat, look away, and one rests on a slab at only 10 m from the leopard, 1323 h. At 1329 h some of the upper tahr start to drift up the slope. As the leopard crouches, then rises, tahr whistle, 1352 h. (This situation is portrayed in Fig. 3). The leopard yawns, turns and moves from view. The tahr watch as it evidently moves off, follow a bit, and then turn back to the slabs at 1359 h. I estimated the slope of these slabs at 45°, a steepness over which I could move only with great care.

The following generalizations can be drawn from these accounts. The tahr show typical alarm behavior in the presence of a leopard, including an erect, attentive posture, whistling, and clustering together. However, despite the obvious arousal evidenced by their behavior, the tahr do not flee from a leopard when they encounter it on steep rock slabs, but remain in the vicinity, and keep close watch until it departs.

These accounts also illustrate the importance of surprise for a leopard hunting tahr. Neither leopard seemed to have the slightest chance of obtaining a meal once the tahr were aware of their presence. Surprise appeared to play an important role in the one kill I did observe. On 16 September at 1800 h a group of tahr was just moving from view around a ridge about 200 m across a valley from my observation point (Fig. 4). Abruptly their attention focused into a small gully below and beside them, and they clustered together giving the characteristic whistles. A few seconds later a spotted leopard emerged from the bottom of the gully, with a tahr young, apparently already dead, grasped by the throat. The leopard paused to look back at the clustered group of tahr, and then continued down and across the slope, dragging its kill between its forelegs. The leopard then moved into a nearby shola.

Upon investigation of the kill site, I flushed the leopard down into the shola. The next morning, I located the young, about 100 m further down. It had not been eaten, and the tooth marks on the throat were the only injuries. The leopard's left canine had penetrated below the left ear, and the right canine, just at the back of the mandible. The leopards lower jaw had clamped on the throat, probably causing death by strangulation. There was considerable internal hemorrhaging but no external bleeding.

The practice of dragging the kill into a nearby shola appears to be typical for leopards.

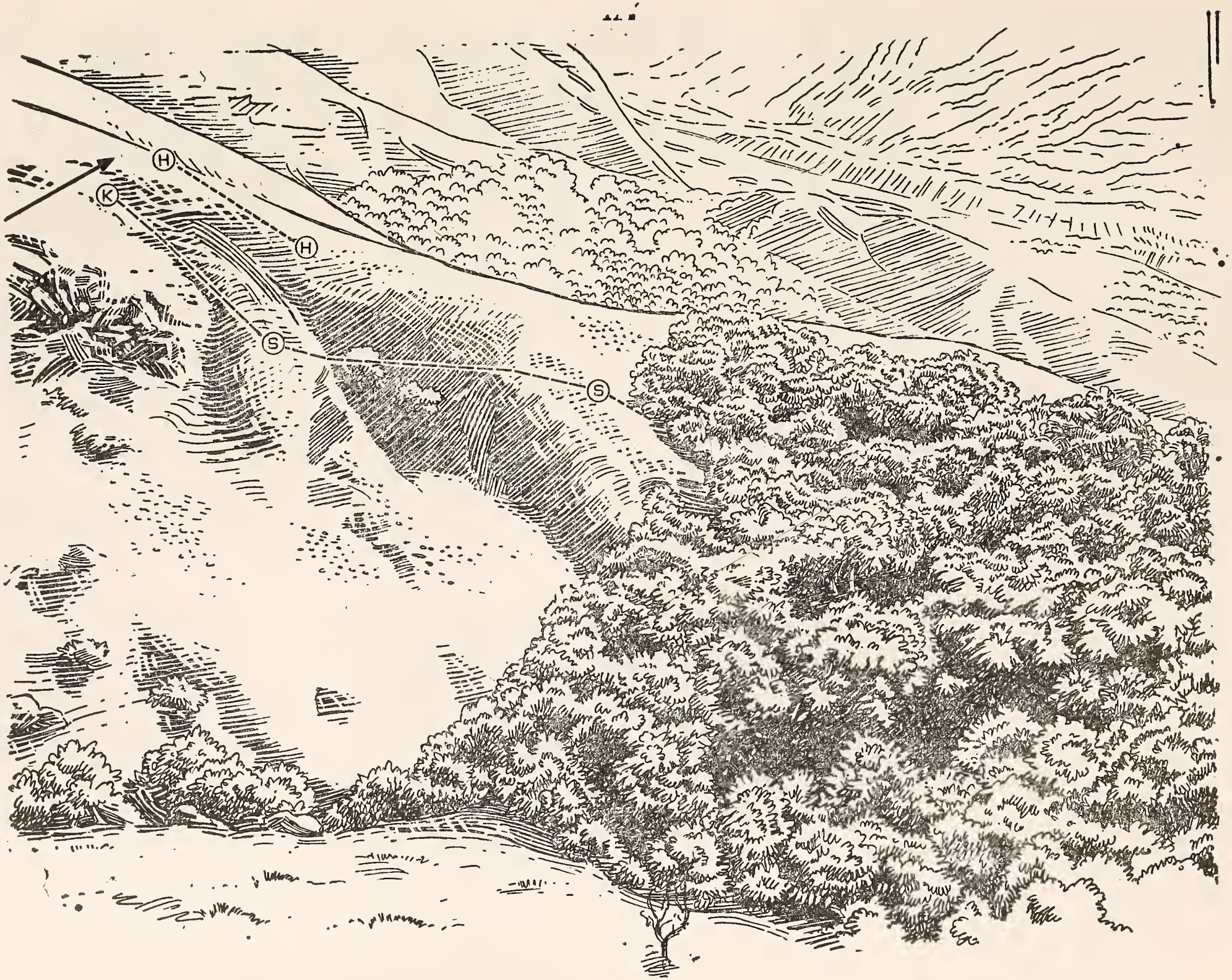

Fig. 4. Hillside showing location of Nilgiri tahr young leopard kill on 16 September 1980. K: where kill was made. Arrow: direction of movement of the tahr group when kill was made. H........H: tahr group cluster movement. S........S: path of the leopard carrying the young with stopping points marked.

Game guide R. Mudhuvan recounted a nearly identical incident to me. I also found a male tahr which had apparently been killed by a leopard. The leopard had started to drag it down the slope. However, the tahr's horns and chin had become wedged between two clumps of *Chrysopogon zeylanicus*, and the leopard had fed off the hindquarters in the open. However, after I collected the head, the leopard returned, and dragged the carcass to the brink of some steep slabs, and let it tumble to a patch of forest below. Sign showed that the leopard proceeded to drag the carcass a few meters into the shola, and then fed on it on several successive nights.

In addition to tahr, a leopard was observed stalking sambar on one occasion, and prey remains in leopard droppings indicate that sambar, Nilgiri langur, and barking deer are important prey for the leopards at Eravikulam (Table 2). Leopards clearly have the most diverse diet of the predators in the area. Leopard droppings from the Grass Hills indicate that they also prey on gaur calves, as five of the six droppings contained their characteristic light brown hair. On the other hand, all of the dozen leopard droppings I collected in tahr habitat in the Mukerti area of the Nilgiri plateau contained tahr hair.

Asiatic wild dog

Unlike tiger and leopard, all indications are that wild dog are not resident within Eravikulam National Park. Prior to 1981, I encountered them on only three occasions, which consisted of sightings of a single dog, a pair, and one trio. The first evidence that a pack was present was when a sambar kill was made near Eravikulam Hut around the first of the year (1981). They continued to be active in the area until the end of the study in September 1981. According to Game Guide R. Mudhuvan, wild dog in the area follow a vertical migration. He told me that for about the last 5 years large packs of 20-25 have moved up from the lowlands in the vicinity of Chinnar, to the northeast. The dogs reportedly split up into smaller groups in the high country, and stay 6-8 weeks before returning to the lowlands. This pattern was said to be repeated about every six months. I was unable to confirm this pattern, but the lack of encounters for extended periods indicate that the wild dogs spend a large proportion of their time elsewhere. Despite this short term of activity, wild dog were encountered more often than both tiger and leopard (Table 1), an indication of the wild dog's diurnal habits.

Most sightings were of the entire pack of nine dogs (Table 3). Wild dog do not show a predilection for roads, and their tracks were rarely encountered. Unlike the felids, wild dog did not leave scrapes, but they did occasionally deposit feces in group defecation sites.

Also, unlike felids, wild dog made no attempt at concealment, but approached their prey openly. By the same token, tahr did not show a very pronounced reaction to wild dog, as the following account from my field notes illustrates:

> At 1143 h on 19 May 1981 a few dozen tahr are on the slopes of Eravikulam Malai. They are about 120 m around the corner from the rock slabs on the east end. Moving in a single line, nine wild dogs traverse the slope about 100 m below the tahr. One dog is out in front, as five of them rest at a gap in a subsidiary spur. The lead dog continues ahead as the tahr stand and watch and give a few whistles, 1147 h. More dogs come onto the crest of the spur, and one dog cuts off to the west, as the main body remains clustered at the gap. The tahr just stand above, 1153 h. A couple of the dogs start zigzagging up the hill towards the tahr. At about 30 m the first tahr turns to move off, while most just stand. The topmost dog gallops up the slope and all the tahr now start moving, and then

> gallop around the corner. Only one dog continues the pursuit just 5-6 m from the last tahr. The second of the leading dogs turns back toward the others scattered 40-60 m below. As the only dog near the tahr approaches, two straggling tahr stand and watch, one looking back over its shoulder, the other facing the dog. As it runs towards them, the tahr turn only when it approaches within about 1.5 m, and take flight. The dog runs along with them, keeping parallel and above. Tahr on slabs above stand watching. At 1202 h one of the dogs still below at the gap in the spur initiates the pursuit of a sambar doe and fawn, and all the dogs scattered above come down to join in (see below).

Nilgiri tahr are also capable of fending off attack by wild dog. This was demonstrated by a dark brown male earlier on the same day. The dogs came across the base of Eravikulam Malai at 1110 h, surprising some tahr in a gully low down on the mountainside. Several tahr took flight across to the east, but one dark brown male climbed onto a small rock projection and turned to face the two dogs that approached him. Wild dog and tahr faced each other, about 1 m apart, the tails of the dogs waving high in the air, as a third dog joined them. Meanwhile two of their companions had chased another tahr off to the east, and leaving the male, these three turned to follow. The male then moved to another slightly higher outcrop. As some of the pack moved down onto the grassy flats just below, two dogs returned to the first boulder, and then up to the new location of the male. The tahr moved out onto the small (*c.* 2 m^2) flat top of the projection, and whirled to present horns to the first wild dog to arrive. More dogs arrived, and the tahr continued to stand facing them as they crowded around the entrance onto the flat top of the boulder, 1119 h. Two dogs dropped down the side in an apparent attempt to find a way up the back side of the boulder, without success, and the dogs departed at 1120 h. The dark-brown male left the rock projection and moved west and up the slope at 1123 h.

However, one should not infer from these accounts of the tahr's mild reaction and successful defense that wild dog are not a threat to tahr, as quite the opposite is the case.

> 17 July 1981. At 0750 h a wild dog arrives from west disturbing a large group of tahr at an artificial salt lick at the base of the south side of Eravikulam Malai. As the tahr take flight across the slope to the east, the balance of the pack arrive and quickly closes in on a lagging female tahr. First one, then a second dog bite and hold the back of the female's thigh, greatly slowing her progress as she makes no apparent move to defend herself. A third dog runs around the front and grabs her by the nose, hanging onto it as she struggles to remain upright. After about 1 min, she is pulled to the ground, as tahr and sambar watch from a distance, although none give alarm calls or whistles.
>
> As two of these dogs commence feeding, one of the three dogs leaves the fresh kill and runs up the slope towards an isolated female tahr standing on a rock slab. The female turns from the approaching dog, but runs across the slab only when nipped in the flank. The dog appears hesitant to cross the wet slabs and turns back down to the kill, as the rest of the tahr and sambar move off to the east.
>
> Now, 5 min after the wild dogs first appeared, it becomes evident why only three dogs attacked the female. Four more are feeding on another kill, a tahr young, about 150 m to the west. Another two dogs are feeding on a third kill, also a tahr young, about 75 m below the second.

The manner in which Asiatic wild dog kill sambar is quite different. This is largely due to the sambar's propensity to take flight into water when pursued by wild dogs. An example of this is the pursuit which terminated the wild dog — tahr interaction on 19 May 1981 described earlier.

> At 1202 h the lowest wild dog of the pack has remained at the crest of a spur emerging from the south flank of Eravikulam Malai. After looking intently down into a shola hidden from my view, it suddenly gives chase as a sambar

> doe and fawn emerge. The rest of the pack immediately turn down to follow as the leader pursues the doe and fawn down the side of a grassy ravine, rapidly closing the sambar's initial 60 m lead. The doe is trotting surprisingly slowly, keeping behind the fawn. The dog passes the doe and cuts in toward the fawn, at which the doe lowers her head, muzzle and neck stretched forward, and rushes the dog, cutting off its attack. The sambar reach the valley floor, and turn up along the grass flats beside the stream. The same sequence of attack by the dog and rush by the doe is repeated, and the wild dog stops. The doe also slows, and then stands briefly before making another rush at the dog, kicking at it with her foreleg. Another two dogs arrive, and as one of them approaches from the other side, the fawn takes flight up the valley as the doe follows. The three dogs now flank the doe, alternately moving in toward the fawn and being repelled by the doe, as the balance of the pack arrives and the flight stops. The dogs continue to harry the fawn, avoiding the charges of the doe, but as one dog rushes in, the fawn turns and takes flight back down along the stream, with one dog in close pursuit. The doe quickly reestablishes her position between the fawn and the dog, but as another dog veers in from the side, the fawn turns and leaps off the meter high bank into the chest deep water. The doe follows, and then immediately turns to face the dogs as the fawn moves to the far side of the 6 m wide stream. During the whole chase two dogs, 3/4-grown pups, have remained behind. 1208 h.

An apparent stand off followed as the doe continued to face the dogs repeatedly sending up sprays of water as she stamped her foreleg, and cutting them off when one or two of the dogs entered the water to approach the fawn (Fig. 5). The sambar seemed to have the advantage, as she could move quickly in the meter deep water, whereas the dogs were obliged to swim. Whether this was true, however, could not be ascertained as observations were terminated by the arrival of four park visitors at 1221 h. Seeing them, the wild dogs abandoned the sambar and climbed up and over Eravikulam Malai.

However, the conclusion to a similar chase was witnessed in Turner's Valley on 27 January 1981. At 1749 h, from a vantage point about 1 km from and 400 m above the river my attention was drawn by a high squealing noise, the "whistling" wild dog sometimes give when pursuing prey (Prater 1980). At that distance I could make out a sambar (which proved to be a yearling male) being attacked by several dogs in a pool in the river. More dogs arrived and entered the water as the thrashing sambar moved under an overhanging tree. When they emerged, several dogs were clinging to the yearling's head. A sambar doe then arrived from the same direction as the others, entered the water, and reared up to come crashing down to strike the dogs with her hooves. Another two dogs arrived and the doe turned toward them, holding the low-stretched threat display and stamping her foreleg repeatedly in the water. One of the newly arrived dogs then joined the melee in the water, as the doe continued her nose to nose face off the dog on the bank. Seeming to find his footing, the yearling male rose up twice in an apparent attempt to shake loose the dogs clinging to his head, apparently grasping his ear and top of muzzle. This struggle continued for several minutes until the yearling ceased struggling at 1752, as the doe continued to direct her attention exclusively toward the one dog on the bank. The wild dogs then pulled the yearling to the water's edge and evidently began feeding. The yearling made one more attempt to rise, only to be pulled down again. The doe remained there as the dogs fed.

These accounts are apparently not exceptions, but the rule, as all of the 13 sambar killed by wild dog were in or near bodies of water. In the incident recounted above, this did not appear to be a result of choice by the

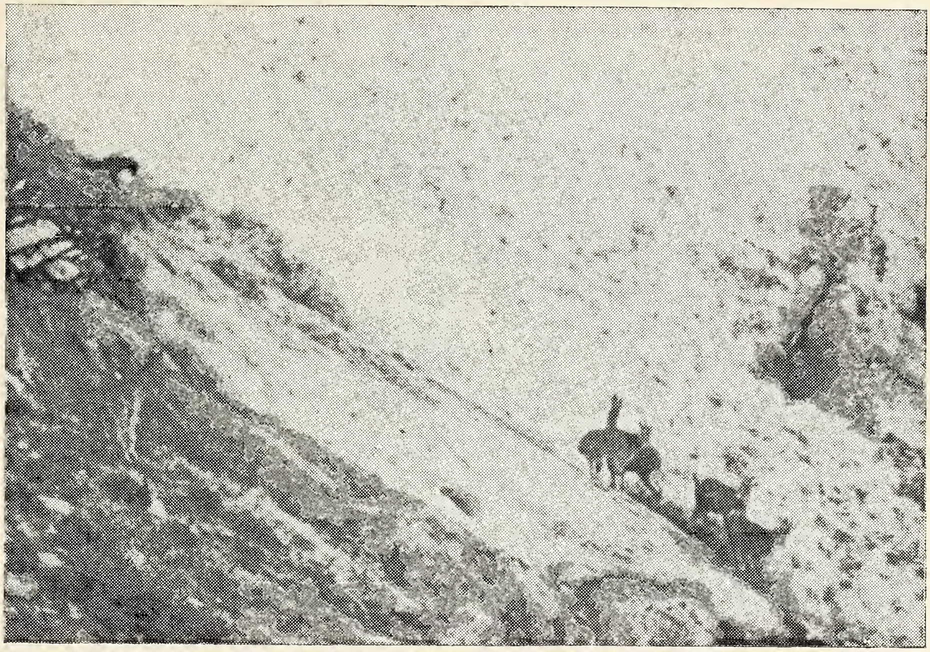

Fig. 3. After an unsuccessful pursuit by the leopard, Nilgiri tahr continue their surveillance of it on rock slabs. 22 May 1980.

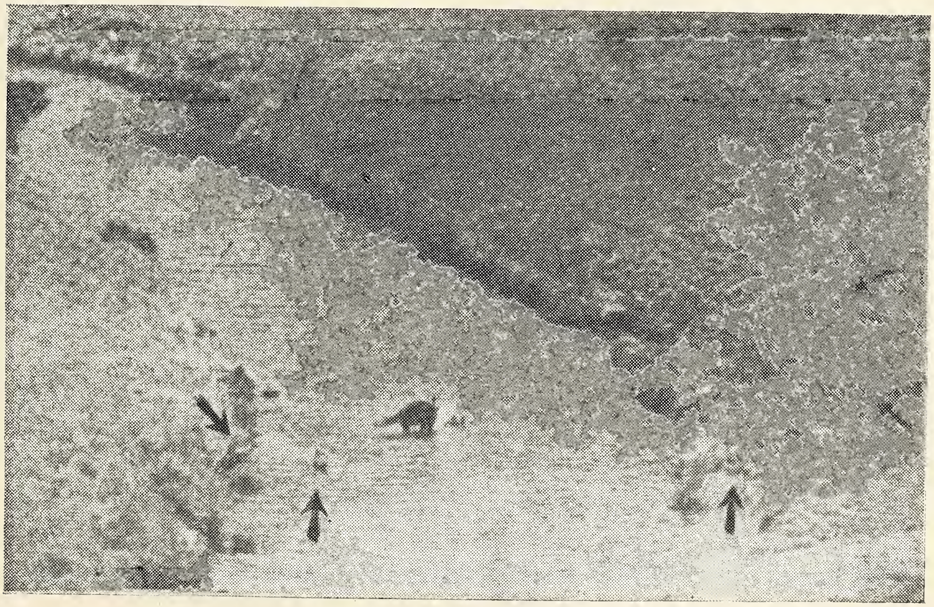

Fig. 5. After a chase, a pack of Asiatic wild dogs converges on a sambar doe and fawn in a stream. The fawn is partially obscured by the water sent flying as the doe stamps forcefully in the water, and threatens a wild dog. Members of the pack are indicated by arrows.

sambar, or else the sambar would have entered the water at the first opportunity instead of fleeing along the bank. Rather, it appeared to be a result of the sambar's tendency to run down hill when pursued. This brought it to the proximity of water, and the pursuit by the dogs seemed to be the immediate reason for entering the water. The thesis that the sambar's flight only incidentally ends in the water was shared by Burton (1940), but contrasts with Johnsingh's (1983) observations. He noted sambar running up over embankments to enter water when pursued by wild dogs on six occasions.

Once in the water, however, sambar seem inclined to remain there. The sambar in the first account could have easily continued their flight onto the other bank. This tendency was shared by a very young fawn I disturbed early one morning in January. It ran to a nearby stream and refused to leave the cold water, despite my close approach.

The ready willingness of sambar does to defend their apparent offspring was also quite evident in these accounts. However, they seemed to have considerable difficulty in doing this effectively. In the first account, this was primarily a consequence of the fawn's reaction of moving away from the attacking dogs, even when this took it away from the doe. As a result, the dogs were able to separate them, at least momentarily. In the second account,

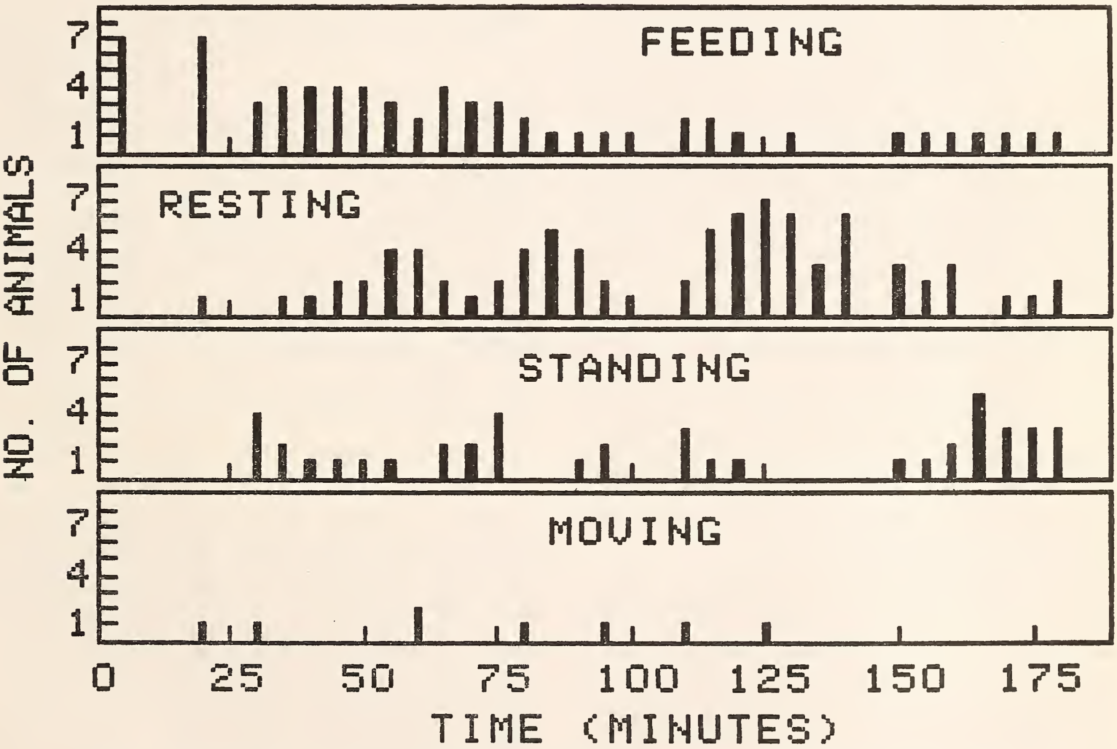

Fig. 6. Number of Asiatic wild dogs visible in each activity in instantaneous time samples after a adult female Nilgiri tahr kill. Starting time: 0645 h, 21 May 1981.

the initial spirited defense was defused by the doe's preoccupation with one single dog, leaving the balance of the pack to dispatch the yearling. An effective defense then, would require closer coordination of the doe and her offspring.

Once the prey was down, wild dog did not employ any specific killing strategy. Rather, they commenced feeding immediately. However, one adult female tahr was pulled down, and then dragged 20 m down the slopes as the dogs fed. Later examination of the kill site revealed a short section of windpipe, suggesting that soon after she was down, one dog attacked her throat. However, this may have been fortuitous as the dogs appeared to begin feeding at any available area. Johnsingh (1983) reported no throat wounds in 40 fresh wild dog prey he examined.

As Johnsingh (1983) has noted, wild dog consume their kills rapidly. When the pack killed an adult female tahr at about 0645 h, I recorded the activity of all visible dogs in instantaneous time samples (Altmann 1974) at 5 min intervals. As shown in Fig. 6, within a half hour, some dogs had left the kill to stand and then rest in the vicinity. Within 1 h and 15 min, most of the prey had apparently been consumed, as only one or two dogs fed from then until they left the kill. Similarly, when the triple kill was made on 17 July 1981, most of the dogs left the tahr young kills after only 20 min, and the adult female kill elicited little interest after 1 h.

Dogs remained alert while resting or standing within the first hour after the kill was made (Fig. 6) and generally oriented away from the prey. This contrasted with those resting 2 h after the kill, when the dogs lay their heads down. It is possible that after the initial feeding bout, dogs maintain a look-out for disturbances. This suggestion is further supported by the manner in which the dogs seemed to "take turns" feeding and watching, as a sitting or resting dog left its position when another dog left the kill to rest or stand.

No single individual led the wild dog pack in initiating departure from the kill, either to drink or to leave the area. Rather, one dog made a move in a particular direction, but then did not continue if the rest of the pack did not follow. Indecisive individuals sometimes stood looking in the direction being considered, which is indicated in Fig. 6 by the greater number of dogs standing around 80-90 and 160-180 min after the kill. This interplay of "leading" and following was demonstrated as the pack left the adult female tahr kill.

At 0948 h one dog abruptly moved west, walking and trotting. He was followed by a second dog at 0951, and both sat on a knoll about 100 m away. At 0952 h three more started west at which time one of the "leaders" resumed his westward move. However, one dog sitting east of the kill was looking east as if intending to move in that direction, but then turned and moved west, as did another dog (0952 h). By the time the seventh dog was on the knoll, the leader was 100 m ahead (0953 h), but two that had moved west earlier then turned back east, and one that was resting midway turned to the south at 0954 h.

As this one dog continued south, three from the west arrived back below the kill. At 1001 h another dog moved south as the first one kept going, but they then started back north at 1004 h. A third dog also came south and sat at the rim of a gully with one of the previous two as the third dropped into a gully, but all three turned back north at 1008 h.

At 1012 one dog started west again, but stalled. Another dog started east, paused to look over his shoulder, and turned back west (1016 h). However, another dog moved abruptly east and others followed at 1017 h. As one of these started along a trail to the east, three dropped down into the shola (1026 h), and two more rose to move that way. At 1033 h, eight dogs emerged from the shola and rested, not far from the kill.

One of these dogs then started to the east again at 1107 h. Five more followed, and joined it on a knoll (1109 h), and a seventh also came over. Then, at 1124 all seven moved single file back to the west, passing below the kill. As they moved on, the last dog came galloping 200 m behind (1129 h).

While I was not able to keep track of all movements on the hillside, this departure from the kill was clearly prolonged and uncertain in direction as over 1.5 h elapsed, including at least six false starts before the final direction was determined.

Evidence from scats (Table 2) indicated that sambar were the primary prey of wild dog, and that tahr and barking deer were also taken on occasion. They also will evidently eat an occasional lizard or snake when the opportunity arises, although I never saw them hunting them. Like most predators (Schaller 1967, Kruuk 1972), wild dog will scavenge when given the opportunity. This same pack consumed a tahr carcass known to be a few days old.

Jackal

Jackals were seen occasionally, sometimes in pairs, but more commonly alone (Table 1). Many of these sightings were within tahr home range (Table 1), but jackal were never seen pursuing tahr. Probably the only time jackals could prey on tahr would be during the first week or two after the tahr's birth, as older tahr would most likely be able to defend themselves from attack. However, there was no indication that even this occurred, and the only observations I had of them hunting were of small grassland animals, probably rodents. On a few occasions jackals passed close to groups of tahr, but neither species showed much interest in the other.

Remains of prey in jackal droppings (Table 2) indicate that jackal use a wide variety of food sources, but depend heavily on rodents. The one dropping containing gaur hair was found in proximity to the gaur killed by a tiger described earlier. This was obviously a case of scavenging, and the same is presumed to be the case with the other ungulate remains found in jackal droppings.

Humans

The potential for human impact on ungulate prey populations in Eravikulam National Park is great considering the small size of the park and the proximity and concentrations of human settlements along the southern and eastern boundaries (Fig. 1). Most of the humans I encountered were collecting plants such as *Drosera peltata,* and these sightings are not included in Table 1. Of the eight parties seen, six contained men armed with muzzle-loaders. I heard one or more gunshots on 11 occasions during the course of the study, giving some indication of the frequency with which these guns are used. Domestic dogs were also used in hunting, and three of the parties were accompanied by dogs. Hunting in Eravikulam was presumably for meat.

One party of men unknowingly demonstrated their method of hunting tahr to me. On 21 February 1980, five men, two of whom were armed, accompanied by five domestic dogs were first seen along the northern flank of Inaccessible Valley at 1115 h. After apparently not locating suitable prey on the slopes above, the men moved down toward the valley floor, and out of sight at 1130 h. Then at 1145 h the two armed men and one of the dogs reappeared traversing along the top of a low set of cliffs where they were attempting to reach a lone saddleback. However, before the lower men could signal those up top, the saddleback made its way off to the side and out of sight. The men reassembled and moved off in the direction the saddleback had gone at 1239 h. In light of the behavior described earlier for the dark brown male tahr confronted by wild dogs, it appears that these men anticipated a similar reaction, and using their domestic dogs to confine and occupy the tahr, hoped to be able to approach and shoot it.

This is evidently what transpired in another incident on 16 July 1981. I first heard dogs barking, evidently in chase, and a shot fired across Turner's Valley at 0935 h, but mist obscured the view. The barking resumed at 1002 h, followed by another gunshot. The mist then cleared at 1014 h, and I saw five men, two of them armed, dropping down a ridge on Poola Malai, to a point where it ends in a set of cliffs. The men apparently saw me as well, as I was sitting in the open about 1 km across the valley, and they moved down beside the cliffs to the edge of a strip of shola, apparently hiding. One of their dogs, however, moved up to where a saddleback was lying in a shallow gully. Eventually one man crawled up and dragged the saddleback down to the shola, which was the last I saw of them.

If my deductions are correct, one collared female was shot a day or two before I found her on 03 May 1981. The only marks on her were a pencil-sized hole in the middle of her right side, and some flesh missing from her udder and inguinal region, which probably corresponded to the exit point. (The pack of wild dogs scavenged this kill before I had the opportunity to perform a more complete necropsy).

Tahr are also poached using wire snares. I found one such setting at the southern end of the park, made of stiff wire about 3 mm in diameter. A large light brown male showed up in the Vaguvarrai home range wearing a collar of similar wire, and one female in a large mixed group in the Grass Hills sported a colorful wire noose.

Although I have scanty data on interactions between tahr and poachers, I had ample opportunity to observe their reactions to my own presence. At the onset of the study, tahr showed a flight distance from me of about 300 m, and individuals outside the Vaguvarrai intensive study area retained this response through the course of the study. Tahr moved away at even greater distances, but then usually at a walk. When surprised at closer proximity and when the nature of the disturbance was plain, tahr took immediate and direct flight. The nature of this flight was as if the tahr had two priorities : (1) to increase the distance between themselves and the human, and (2) to get out of sight. In cases where these two aspects conflicted, the later seemed to take precedence. However, I never saw tahr move closer in an attempt to get out of sight, but they did sometimes move at right angles to the line between us if that took them immediately out of my view. If tahr were away from the typical flight cover of steep cliffs and slabs, moving in the direction of these also seemed to be a priority. Once out of sight, tahr usually walked quickly to slabs or cliffs if none were in the immediate vicinity. Once on the slabs, they usually stopped and stood, the gray pelage of the females and subadults closely matching the color of the gneiss. They often did not move further than the nearest steep terrain upon first being disturbed, but moved much farther if disturbed a second time. On rare occasions tahr took flight across the open plateau. The longest flight I recorded was about 1,200 m, across the north side of the top of Kattu Malai.

Sambar also fled from humans at distances up to 300 m. Their response differed from that of tahr primarily in that sambar took flight into sholas, rather than to cliffs.

CONCLUSIONS

In Eravikulam National Park, tiger, leopard, and jackal may be considered residents. While it is not possible to state their abundance in absolute numbers, the evidence indicates that tiger are few, whereas leopards are more numerous. Asiatic wild dog and humans are temporary visitors to the park, and their numbers fluctuate accordingly. Wild dog appear to visit the high country, including the park, for several months at a time, whereas human visits are presumably of a duration of a few days or less.

It is clear that tahr and sambar react quite differently to the different predator species. Stalking predators, (leopard and tiger) are kept under surveillance until they leave the area, whereas wild dog do not elicit a strong reaction. A similar difference in the reaction of prey species to stalking and non-stalking predators was noted by Schaller (1972) in the Serengeti ecosystem. The tahr's flight distance from man is commensurate with the distance at which man can inflict damage on tahr. The manner of flight is also in keeping with method of attack, as line of sight and "line of bullet" are essentially the same. Thus, one cannot specify a generalized "predator response" for tahr, because the response varies significantly with the predator involved.

The clustered, agitated surveillance of a predator in the open exhibited by Nilgiri tahr has been reported for other ungulates, notably chital (*Axis axis*, Muckenhirn in press) and Thomson's gazelle (*Gazella thomsoni*, Walther 1969). While Muckenhirn refers to such behavior as mobbing, Walther terms it a fascination behavior, stating that it is similar to mobbing, but lacks aggressive intent. Nilgiri tahr and chital also showed no indications of aggression in this context and therefore, the term mobbing is somewhat misleading, as it definitely connotes an aggressive response. With this in mind the continuum of antipredatory defenses proposed by Berger (1979), from retreat through stare, 'curious', follow, and attack seems somewhat questionable. Certainly, the continuum exists with reference to the physical movement of the prey relative to the predator, but from a motivational standpoint the connection is less certain. Contrary to expectation, a tahr (and presumably a chital or gazelle) engaging in 'curious' following is not on the verge of attack, but on the verge of flight, as was so readily evident in the encounter with the leopard on 29 April 1980 described earlier. It is also appropriate to distinguish offensive and defensive aggressive responses against predators as Walther (1984) has done for intraspecific social behavior. While the behavior of a sambar doe rushing towards a wild dog, giving a low-stretch threat and kicking with the forelegs, is clearly offensive, the male tahr that held off several wild dogs was using the horn threats defensively. This difference is also difficult to incorporate into Berger's continuum. Rather it seems appropriate to consider the various antipredator defenses as discrete responses to the particular prey, predator, and circumstance.

The contrast between the male tahr's successful defense against several wild dogs and the adult female which was pulled down without a trace of aggressive behaviour is seemingly incongruous. Noting similar responses of prey when cornered or caught by predators in the Serengeti, Schaller (1972) wrote, "...it is surprising that such weapons as horns and teeth, which are used consistently in intraspecific strife, are wielded infrequently..." However, this question can be resolved, perhaps, by considering the predator-prey encounter from the perspective of the prey, and considering its normal intraspecific social behavior. In the aggressive encounters witnessed, the prey did not show any specialized behavior towards the predator, but rather utilized the same displays and aggressive acts employed in encounters with conspecifics (low-stretch threat and foreleg kick in sambar, and horn presentation in tahr). It may, therefore, be that tahr consider the close approach of a predator as a violation of its individual distance, rather than a threat to its life. In its normal social life, an ungulate reacts to such a violation in one of two ways. If it is submissively motivated (as is presumably the case automatically with large predators), the animal withdraws (flight). The alternative is to respond aggressively, which manifests itself, against predators, as defense. Furthermore, during extensive observations on Nilgiri tahr, it was evident that once one contestant in a intraspecific conflict was injured or suffered apparent pain, the reaction was to take immediate and precipitous flight. Therefore, once the predator's attack succeeds in wounding the prey, the prey's sole motivation is likely to be flight. Even though flight is rendered impossible by the predator's hold, the prey is nevertheless evidently "locked" into the flight response, and cannot change this to aggression.

As leopards depend on concealment to get close enough to their prey to gain the advantage of surprise, the sharply contrasting color phases of leopard, spotted and black, has important implications for their success in hunting. In the relatively open terrain of Eravikulam, the jet black coloring of the dark phase is conspicuous to such an extent that one might expect them to be obligatory nocturnal hunters. However, this was not the case, as black leopards were seen active and hunting in broad daylight, as was evident in the accounts given above. Robinson (1969) has demonstrated that the black phase represents a double recessive genotype, and gives evidence that the recessive incurs some reproductive cost. Spotted females had an average litter size of 2.09, whereas black females had an average litter sizes of 1.70. This apparent cost of melanism must be counteracted by other advantages for the trait to remain in the population. Presumably, the advantage is that black leopards have a greater success in hunting at night or in the sholas.

This review of predator-prey relations at Eravikulam National Park has shown that sambar provide the main prey base for the large predators (tiger, leopard, and Asiatic wild dog). Leopard utilize a number of other prey species, particularly Nilgiri tahr, Nilgiri langur, and barking deer. Jackals scavenge kills of larger predators, but prey primarily on rodents. Humans were seen pursuing tahr, but gunshots emanating from valleys indicated that forest animals (sambar, gaur, barking deer, and Nilgiri langur) were also hunted.

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SOME OBSERVATIONS OF THE ETHNOLOGY OF THE NICOBARESE WITH SPECIAL REFERENCE TO *COCOS NUCIFERA* LINN[1]

H. S. Dagar[2] and J. C. Dagar[3]

Cocos nucifera Linn. grows wild and is also cultivated in the Nicobar group of islands. Various ethnobotanical uses by the Nicobarese aboriginals have been described. The uses of 44 other plant species in combination with coconut palm as ingredients in medicine have been explored. The tree has been assessed as "tree of life" among Nicobarese.

The Andaman and Nicobar Archipelago situated in Bay of Bengal lies between 6° and 14° N latitude and 92° and 94° E longitude. The Nicobar group (separated by 'ten degree channel' from the Andaman group) from northern most Car Nicobar to Great Nicobar Island stretches about 293 Km on length and has a maximum width of 57 Km and occupies an area of about 1953 sq Km. The Nicobar Islands consist of about 28 islands and the major islands are Car Nicobar, Chowra, Teressa and Bompoka (north group); Katchal, Nancowry, Trinket and Kamorta (Central group); Pullomillo, Little Nicobar, Kondul and Great Nicobar (South group). These islands show a uniform tropical warm humid climate with the temperature ranging from 22°C to 32°C; average annual rainfall ranges from about 300 cm in north to about 380 cm in south. Mean relative humidity is about 85%.

..*Cocos nucifera* Linn., (Coconut tree) is widely cultivated in tropical regions of both Old and New World. Considerable controversy exists as to the original home of coconuts (Beccari 1917, 1919, Hill 1929, Patel 1938, Menon & Pandalai 1960, Purseglove 1968 and Tanaka 1976). Many of these believe that it might have originated in any one of the places in South East Asia from Malaysia to Melanesia. According to Baker (1970) it may actually be more closely related to the palms of Indian ocean than to New World's native palms. It has been supposed to be indigenous in the Indian Archipelago and on the Nicobar and Cocos islands of the Bay of Bengal—and this would explain its early cultivation on the coasts of India and Ceylon (Blatter 1926). In view of these controversies it is interesting that it grows in wild populations in several islands of Nicobars including Car Nicobar, Teressa, Tillangchong, Katchal, Kamorta and Little Nicobar. Balakrishnan & Nair (1979) have compared various parameters of tall and dwarf plants in these islands. However, more interesting is that the aboriginals of these islands are dependent on *Cocos nucifera,* so much in their ritual and religious ceremonies, food, medicine and various other applications that it appears *'a tree of life'* to them. Some of these applications have been dealt in this paper after extensive studies in these islands:

1. *Vernacular names*: All the Nicobarese speak a language, called 'nicobarese', though

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some dialectic differences exist in three different groups of islands. Various parts are named by the following names in Central Nicobarese language (Man 1889):

Coconut tree (young) — hishöi
.... (After commencing to bear) — Chía oyàu
.... fruit — Yuang — oyàu
.... leaf (young) — nêak; (mature green) — dai-oyàu; (withered) pâl-oyàu.
.... flower spathe — shíat-oyàu
.... leaf stalk — lamoah-oyàu
.... leaf sheath — hen hâl — oyàu
.... fruit stalk — chaiyuh — oyàu
.... husk (of ripe nut) — Kentóit; (of unripe nut) — Kato;
.... shell (entire) — hishoya (as used for holding water).
.... shell-full — hishoya-oal
.... shell half (for use as cup) — enfâ; taiyâk
.... shell half (for baling canoe) — tane- dâk-düe
.... shell piece — endain-tat
Coconut shell (immature) — Müak - ninàu
.... Kernel (of ripe nut) — enyul; (of unripe nut) — henchain; (of sprouting nut) — höak
.... rind of Kernel — Kafat — yuang-oyàu
.... Kopra (dried Kernel) — ngoât-ta-koâp
.... paste — ngoât-ta-koín-ha.
.... water (of ripe nut) — dâk-ngoât
.... water (of half ripe nut) — dâk-ninàu
.... scraper — ok-hang-ai
.... scraper (ripe, husked) — yuang-oyàu-hetch-ât
.... scraper (ripe unhusked) — Yuang-oyàu-hokok
.... scraper (unripe husked) — ninàu-hetshât
.... scraper (unripe unhusked) — ninàu-hokók
.... (ripe shell) — kaiyuâk
.... (unripe shell) — Kanlônga
.... tree tabooed — Oyàu-henhwâva.
.... toddy — kaut.

2. *Coconut in folk tales and folk songs*: There are many tales in the folk lore of the Nicobarese but people living in Car Nicobar tell a story about the genesis of coconut tree. "Once upon a time", they say, "there was a great scarcity of water on the island. From somewhere a man appeared who through sheer magic produced water from his elbow. The people, thinking him to be a devil incarnate, choped off his head. But a tree sprouted where the head fell and that grew big and began to bear fruit resembling the head of the be-headed man. People were afraid to touch the tree or to eat its fruit. Ripe fruits continued to fall, and many trees grew, resulting in a dense coconut grove. An old man who lay dying; was persuaded by some wise men to taste the fruit. The old man found it so delicious that he continued to eat the nuts and drink the water of these nuts. He regained his strength and began to look like and feel a young man. Therefore, the people began to eat the coconut".

Folk songs sung by Nicobarese on various occasions of joy, in ceremonies and rites are rich in references to plants, particularly about coconut tree. The following song in Car Nicobarese is indicative of the deep insight, common sense and practical wisdom of aboriginals:

Ma ön ngoh to ô kö
Nö raneh lö kuihi
Rôl kangen talöökö an

Nö vi karen nö anahan nômö hi
Heng kangen nun minë roi
Hêng Kangen nun minë sét
Ot ngö re pöri nup rong
Hol re to nup up inre
Po hî nya kafa nö re
Oi lö tö lâ in u
Pati i vö in tö ngam kaha taôkö
Keu heut tö ren taneûngen in inup alaho
Yeh yen tö i ha öo nyö ó no alhaha hî

This piece of folk song means; "Coconut tree is the means of our Life and can be used in many ways in our traditional life. The leaves and fruits give us cloth and food. The trunk is used in constructing huts. There are various other uses also. Considering it to be the tree of life, let us sing in praise of it."

3. *Coconut in rituals and traditional religion*:

The traditional practice of keeping as much close and healthy relationship as possible with the dead is kept up by the Nicobarese of Katchal, Nancowry and some other islands. skull of the buried person is retained in the house for sometime and food is served to it and later it is buried again. At the time, a 'takoya' mark is made, as an indication that nobody should use the coconuts of a particular tree(s), as it remains in the sole charge of the spirit of the dead. Animism has been the traditional religion of the Nicobarese, largely marked by the dominance and interplay of spirit worship, witch-doctors (specially in Chowra island) and animal sacrifice. In order to worship and keep the spirit happy, they hang, every year, a few coconuts sprinkled with cock blood, by the ceiling of their huts. At times the leaves of some trees, and green coconuts are hung at the entrance to a sickman's room. Nicobarese also observe a communal festival as a precaution against evil spirit and the coconut leaves are hung at various spots in the villages. Coconut trees along with canoes and huts will descend to the surviving members of the family according to their traditional law of inheritance.

4. *Medicinal and other uses*:

Tapping of toddy from the unopened spadices of coconut, making various preparations from kernels and coconut oil, feeding raw or ripe nuts to domestic animals, using the tree trunk as timber for hut construction and leaves for thatching and crafting mats, screens, baskets, etc, and preparing pag shedheaths and bathrooms from leaves, extracting fibre from leaves, using leaves and fibrous mesocarp of fruits as fuel, and shells as domestic utensils, etc, are some of the traditional uses of the coconut tree. By striking the shells in the evening they call the pigs to their respective hearths, leaves are burnt during night as torch for hunting the octopus and crabs while the fibrous pericarp of the shell is burnt during night as mosquito repellent. Nicobarese depend upon coconuts and areca nuts (*Areca catechu* Linn.) for their trade as they have been exchanging these for other useful items since ancient times. Now, the surplus nuts are also sold out for cash. The oil is extracted from coconuts which is classed as edible, lubricant and luminous. Besides the above mentioned uses the coconut tree is a useful medicinal plant. In China, the bark of the root is recommended as astringent and styptic to treat hemorrhages and fluxes, in Indochina, the roots are regarded as antipyretic and diuretic to treat blennorrhoea, liver trouble, and, in decoction with some other roots for, bronchitis, in Malay Peninsula these are pounded into a poultice to treat venereal diseases, also ground up with goose bones and prescribed as an antidote against *Datura* poisoning, and the ash of the shell, with wine, is a treatment for certain phases of syphilis (Perry 1980). The Nicobarese use coconut as an ingredient of many drugs. Coconut water commonly known as *'daab paani'* is a laxative and refreshing drink and taken for jaundice and other diseases also, but the oil has been used by Nicobarese as an ingredient of many drugs prepared from various plant species. Some of these have been dealt here in the following account :

i) Green leaves of fern *Vittaria elongata* Sw. mixed with coconut oil and leaves of *Lepidopetalum jackianum* Radlk. and *Pongamia pinnata* (L.) Merr. are made into a paste used for curing rheumatism and stiffness of swollen joints. Similarly *Masserschmidia argentea* (L.f.) Johnst. leaves macerated in coconut oil are rubbed on body in lumbago. Other combinations of coconut oil for rheumatism and lumbago are leaves of *Ipomoea pes-caprae* (L.) Sweet and *Euphorbia atoto* Forst. f., leaves of *Scaevola taccada* (Gaertn.) Roxb. and *Syzygium samarangense* (Bl.) Merr. & Perry; roots of *Clerodendrum inerme* Gaertn. *Glochidion sumatranum* Miq. leaves mixed with leaves of *Colubrina asiatica* (L.) Brongn. and coconut oil is used for making a paste for sprained muscles and dislocated joints. Tender twigs of *Bruguiera gymnorhiza* Lamk. mixed with *Ocimum sanctum* Linn. and coconut oil are rubbed on body in tiredness and the latter mixed with the leaves of *Duranta plumieri* Jacq. is rubbed on swellings. Leaves of *Cassia occidentalis* Linn.; *Datura metel* Linn. and *Solanum nigrum* Linn.; pounded together in coconut oil are rubbed on as a cure for bodyache.

ii) The pounded leaves of *Cassia tora* Linn. mixed with coconut oil is boiled and rubbed on the body in cutaneous diseases. *Cayratia trifolia* (L.) Domin is also used similarly as the above species.

iii) Leaves of *Calophyllum inophyllum* Linn. pounded with *Piper betle* Linn. leaves and coconut oil and sea water are tied with a bandage on fractured bones and to cure sprained muscles. Leaves of *Clerodendrum inerme* (L.) Gaertn. and *Leea aequata* Linn. are also used in the same way. Combination of coconut oil with the leaves of *Ficus ampelas* Burm., *Morinda citrifolia* Linn. and *Colubrina asiatica* (L.) Brongn. is also used for fractured bones.

iv) *Cleidion nitidum* Thw. and *Leea aequata* Linn. are boiled to make a paste with coconut oil, cooled and applied on large cuts and wounds. Tender leaves of *Solanum melongena* Linn. warmed and smeared with coconut oil are kept on ulcers for making pus concentrate at a point and for relieving pain.

v) Leaves of *Euphorbia atoto* Forst. f. pounded with turmeric (*Curcuma longa* Linn.) and coconut oil, boiled and taken for healing up the wounds in throat, mouth cavity, and for gums.

vi) Green leaves of *Alstonia macrophylla* Roxb. along with leaves of *Morinda citrifolia* Linn. are macerated in hand and mixed with coconut water and drunk during severe stomach ache.

vii) Twigs and leaves of *Ochrocarpus volubilis* (Lour.) Merr., pounded with leaves of *Cassia occidentalis* Linn. are boiled in coconut oil, cooled and rubbed on the body to cure pneumonia.

viii) Green leaves of *Dimocarpus longam* Lour. pounded with *Cassia occidentalis* Linn. and coconut oil are rubbed on the body of a child as febrifuge. Green leaves of *Cassia occidentalis* Linn. are crushed in coconut oil and rubbed on the body of the newly born child having fever.

ix) Leaves of *Peperomea pellucida* (L.) HB&K boiled in coconut oil and rubbed on body of newly born child. This paste is also used by young people to assist muscle development.

x) Leaves of *Solanum nigrum* Linn., *Datura metel* Linn. and *Cassia occidentalis* Linn. are pounded together in coconut oil and rubbed on body in fever. Leaves of *Dendrobium crumenatum* Sw. are boiled in oil and rubbed on body in fever. The inflorescence of *Cyperus javanicus* Houtt. is pounded with coconut oil and after keeping in sunlight for about half an hour rubbed on body as diaphoretic agent in cold, fever, and malaria. Similarly green leaves of *Gossypium herbaceum* Linn. crushed with castor and coconut oil are boiled in a little water and the paste is used as febrifuge and diaphoretic in malaria and fevers giving shivering. *Hyptis capitata* Jacq. leaves are also pounded in coconut oil and rubbed on body as febrifuge.

xi) Green leaves of *Triumfetta rhomboidea* Jacq. pounded with rhizome of *Zingiber officinale* Rosc. and fruit of *Citrus limon* (L.) Burm. f. are fried in coconut oil and taken for cough and bronchial complaints.

xii) Leaves of *Stachytarpheta indica* (L.) Vahl are boiled with castor oil and 'tari' and after cooling given to women in fever after delivery.

xiii) A few seeds of *Trichosanthes bracteata* (Lamk.) Voigt. are added to 'tari' drink for enhancing its effect.

xiv) Entire plant of *Solanum surattense* Burm. is macerated in coconut oil and given to cattle before they give birth to their calves.

xv) Green leaves of *Parabaena sagittata* Miers. are crushed in coconut oil and the paste is used on the incision of snake bite.

We can conclude that coconut-tree is being used as a basic unit for food, medicine, shelter, trade and above all in religious and ritual traditions by the aboriginals of Nicobar islands. It has proved 'a tree of life' for them.

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TAXONOMIC STATUS OF *HARPIOCEPHALUS HARPIA MADRASSIUS* THOMAS, 1923 [CHIROPTERA, VESPERTILIONIDAE] WITH COMMENTS ON OTHER DESCRIBED FORMS UNDER THE GENUS *HARPIOCEPHALUS* GRAY, 1842[1]

P. K. Das[2]

Based on a recently collected specimen from an ancient rain forest area of the Silent Valley, Kerala, *Harpiocephalus harpia madrassius* Thomas, 1923, has been synonymized with *Harpiocephalus harpia lasyurus* (Hodgson, 1847). Characters given for different described forms under the genus *Harpiocephalus* Gray, 1842, have been discussed and their external and skull-measurements appended. Since characters (*e.g.*, size, colour and dental features) of different described forms overlap, further studies on fresh material might possibly prove that both the genus *Harpiocephalus* and the species *Harpiocephalus harpia* (Temminck) are monotypic. Distribution of *Harpiocephalus harpia* as also a note on its biology have been added.

INTRODUCTION

Harpiocephalus harpia madrassius Thomas, 1923, was described on the basis of two female specimens: one, the holotype, collected by Charles McCann of the Bombay Natural History Society from Perumal, Palni Hills, Madurai District, Tamil Nadu, India, and the other from the Malabar coast, Kerala, India, already present at the British Museum. Ever since McCann collected the female specimen mentioned above, on 29th March, 1922, no further specimen of *Harpiocephalus* was obtained from that part of the country. The Silent Valley Expedition of the Zoological Survey of India was able to procure a male example of this bat on 23rd January, 1980, from the original rain forest area. Attempts to identify this third and the only specimen beyond the types of this subspecies demanded fresh evaluation of the taxonomic status of *Harpiocephalus harpia madrassius* Thomas in particular and the problem of subspecies in *Harpiocephalus harpia* (Temminck) in general.

TAXONOMIC STATUS OF *Harpiocephalus harpia madrassius* THOMAS

Harpiocephalus harpia madrassius was established by Thomas (1923) on the basis of its differences in size (longer forearm) and colour from the nominate subspecies (type locality Java), and from the northeastern Indian population which he recognized as a distinct subspecies of *Harpiocephalus harpia,* namely *H. h. lasyurus* (Hodgson, 1847), type locality Darjiling, Darjiling District, West Bengal, India. An examination of these two parameters, *viz.*, size and colour in the northeastern and southern Indian populations reveals the following:—

SIZE: Table 1 gives the external and skull-measurements of the Indian material of *Harpiocephalus harpia* present in the National Zoological Collections of India (Zoological Survey of India) along with those of other

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material of this species present elsewhere (on the basis of published literature and personal communications).

A careful perusal of Table 1 shows that Thomas's (1923) contention of the alleged size differences between the northeastern and southern Indian populations is not correct. Again, according to Thomas (op. cit.), the females of *Harpiocephalus* are larger than the males, the difference being conspicuous in the skulls. Measurements shown in Tables 1 and 2 indicate that the females do have a tendency of being larger than the males. The male specimen from the Silent Valley, being a representative of the larger-sized subspecies *madrassius,* is expected to be larger than the males of the northeastern Indian subspecies *lasyurus.* But, this adult specimen, in fact, has a forearm-length (44.7) much smaller than those of the northeastern Indian males and is only slightly longer than that of the unsexed holotype of *Noctilinia lasyura* Hodgson, 1847, from Darjiling. The alleged size differences between these two Indian populations are, therefore, not borne out.

COLOUR: While describing his *Noctilinia lasyura,* presently regarded as *Harpiocephalus harpia lasyurus,* Hodgson (1847) gave its colour as "bright rusty above, sooty below; the hairs tipped hoary" to which Thomas (1923) adds, "the ground colour is much browner". The colour of *H. h. madrassius* has been given as "bright rufous, ... the grey woolly underfur contrasting with the red of the tips of the hairs" (Thomas 1923). The material (three skins and four specimens preserved in spirit) at my disposal provides an opportunity to examine the colour in the Indian examples of *Harpiocephalus harpia.* The original colour of the older specimens has certainly changed to some extent — that of the dry skins due to "foxing" which is but natural under the tropical conditions of India and of the specimens preserved in spirit due to the dissolution of certain pigments of their pelage. Nevertheless, if these specimens are arranged in the descending order of depth of their coat-colour, the skins and specimens preserved in spirit can be arranged in the following manner (dates of collection are given in parentheses) —

Sikkim ♀ (skin, 1946), Silent Valley ♂ (skin, 1980), Darjiling ♂ (skin, 1851), Karsiyang ♀ (spirit, after 1881), Cherrapunji ♀ (spirit, 1868), Karsiyang ♂ (spirit, after 1881), Darjiling ♂ (spirit, 1872).

It is seen that no two specimens of the above lot are exactly of the same colour, and the male from the Silent Valley cannot be separated from the northeastern Indian population on the basis of its colour. In fact, that colour in Chiroptera is not of much taxonomic value has aptly been stated long ago by Dobson (1878), and in recent years subspecies based on colour differences are being synonymised (Agrawal 1973, Sinha 1980).

Also, the baculum of the specimen from the Silent Valley in structure and dimensions is similar to that of *H. h. lasyurus* studied by Agrawal and Sinha (1973).

Under these circumstances where the northeastern Indian population does neither differ in size, in the structure and measurements of the baculum nor in colour from the southern Indian population, I do not hesitate to synonymize *Harpiocephalus harpia madrassius* Thomas, 1923, with *Harpiocephalus harpia lasyurus* (Hodgson, 1847).

Following Tate (1941), Ellerman and Morrison-Scott (1951) doubtfully placed *"Vespertilio pearsonii* Tomes, 1858" instead of *Lasiurus pearsonii* Horsfield, 1851, as a synonym of *Harpiocephalus harpia lasyurus* (Hodgson). Horsfield (1851) while describing his *Lasiurus pearsonii* gives sufficient description with measurements and mentions the donor and the locality of the lone specimen on which his taxon is based. These are enough to date this species from Horsfield (1851). Tomes (1858) simply transferred *pearsonii* Horsfield, 1851, from *Lasiurus* to *Vespertilio,* re-examined and gave further descriptions of Horsfield's type (from Darjiling) as also of two other specimens, one from "Nepal" and the other from "Ambonya" (=Ambon), Molucca Isles, Indonesia. As such, Ellerman and Morrison-Scott's (1951) statement regarding the type locality, "Locality unknown" is erroneous and *Lasiurus pearsonii* Horsfield, 1851, should be brought back under the synonymy of *Harpiocephalus harpia* (Temminck), as was done by Dobson (1876, 1878) and Blanford (1891).

Comments on the described forms under the genus *Harpiocephalus* Gray

The genus *Harpiocephalus* was established by Gray (1842) to accommodate *Vespertilio harpia* Temminck, 1840, indicated by him as *H. rufus,* a *nomen nudum.* Dobson (1876, 1878) and Blanford (1891) considered *Noctilinia lasyura* Hodgson, 1847, as a synonym of *Harpiocephalus harpia* (Temminck), who also included species now maintained under the genus *Murina* Gray, 1842. Miller (1907) restricted *Harpiocephalus* to the type species only. Thomas and Wroughton (1909) considered the Himalayan form *H. lasyurus* (Hodgson) as a species distinct from the Javan *Harpiocephalus harpia.* Allen (1913) described his *Harpiocephalus rufulus* from Tonkin, Vietnam, on the basis of it being smaller than the Javan species, besides some differences in colour between these two forms. Wroughton (1918) also treated *lasyurus* as a full species. Thomas (1923) was not aware of *H. rufulus* Allen, 1913, and described his *Harpiocephalus mordax* from Mogok, northern Burma, as the second species under the genus, *lasyurus* being considered by him as only a subspecies of *H. harpia.* He characterized *mordax* as being larger than *harpia,* "brightest rufous" in colour and having some structural peculiarities. Tate (1941) pointed out that one of the syntypes of *Vespertilio harpia* Temminck, 1840, was tagged with a skull of a *Myotis.* Ellerman and Morrison-Scott (1951) who treated *Harpiocephalus* as monotypic with *lasyurus* (Hodgson), *rufulus* Allen, *madrassius* Thomas and *mordax* Thomas as subspecies of *Harpiocephalus harpia,* had some doubt regarding the specific distinctness of *mordax.* Husson (1955) could trace out the original skull of one of the two syntypes of *Vespertilio harpia* Temminck, 1840, the skin of which was tagged with a skull of a *Myotis,* and designated the other syntype, the one already with its original skull, as the lectotype of *Vespertilio harpia* Temminck.

An analysis of characters given for different forms of *Harpiocephalus* show that they all, excepting *mordax,* differ from each other only in size and colour — *mordax,* in addition, is said to have some dental peculiarities.

Table 2 gives measurements of non-Indian forms of *Harpiocephalus* (compiled from published literature). It would be seen that the adult male holotype of *rufulus* Allen has a forearm-length (44.0) nearly equal to that of the holotype (unsexed, presumably a male) of *N. lasyura* Hodgson (44.3) or the male from the Silent Valley (44.7) (Table 1). Again, the type (a female) of *mordax* from northern Burma with a forearm-length of (54.0) closely approaches that of the type specimen (female) of *madrassius* (53.5) (Table 1). It would, therefore, follow that differences between the different described forms with respect to size are not of much consequence.

Again, different authors have described the colour of various species and subspecies of *Harpiocephalus* in different ways. Thus, the colour of *harpia* has been stated as bright rufous (Thomas 1923) and as orange rufous (Tate 1941), that of *lasyurus* as bright rusty (Hodgson 1847), of *rufulus* as duller red than *harpia* (Allen 1913) and of *mordax* as brightest rufous (Thomas 1923). All these colour descriptions are based on one or two specimens. But when a number of specimens from the same geographical area are examined for their colour, this character appears to be highly variable, as has been seen in the small series from northeastern India (*vide supra*). The variation in colour cannot be attributed to age, sex, season or to locality with certainty. Until the contrary is proved, the differences in colour should better be treated as individual variation only.

As has been claimed by Thomas (1923), the premolars of his *Harpiocephalus mordax* are slightly broader than the first molar, but in *H. harpia* they are narrower than the first molar. In two of the seven skulls of the Indian material at my disposal the last premolar of the upper jaw (pm^4) is slightly smaller than the first molar of the upper jaw (m^1), in two others they are almost equal in size, in still two others they are equal in size while in one specimen pm^4 is slightly larger than m^1. Therefore, the dental peculiarity claimed for *mordax* is not tenable.

It is, therefore, seen that all the forms (species and subspecies) described under the genus *Harpiocephalus* vary widely in size (Walker *et al.* 1964, give the forearm-length as 40 to 54), colour and even in relative sizes of molars and premolars. These variations cannot be correlated with geographical areas (Kuroda, cited by Ellerman and Morrison-Scott 1951, and Lehmann 1955, reported *H. h. harpia* from Taiwan and Fukien respectively). Further, it is quite pertinent here to recall Allen's (1913) statement that intergradation between the Indian and the Tonkin forms might be expected, and Tate's (1941) statement, "A specimen labelled as *H. lasyurus*, from Darjiling, ..., is at best a weak subspecies of *harpia*". Examination of further, preferably freshly collected material from all over its range of distribution (*vide infra*) is likely to prove that not only the genus *Harpiocephalus* is monotypic but *Harpiocephalus harpia* is also a monotypic species (as was thought by Dobson 1876, 1878, and Blanford 1891) in which growth possibly continues till late in the ontogeny.

DISTRIBUTION OF *Harpiocephalus harpia* (TEMMINCK)

Harpiocephalus harpia (Temminck), as understood above, has, so far, been reported from Kerala (Malabar coast, Silent Valley), Tamil Nadu (Palni Hills), West Bengal (Jalpaiguri District and Darjiling District), Sikkim (hereby reported for the first time, see above and Table 1) and Meghalaya (Cherrapunji) in India; northern Burma (Mogok); southeastern China (Fukien); Taiwan; Viet-nam (Laokai); Thailand (Lekagul and McNeely 1977); Andalas (=Sumatra), Java and Molucca Isles (Ambon) in Indonesia. Tomes (1858) mentions a specimen from Nepal. This specimen was sent by Hodgson who, incidentally, never collected this species in Nepal but did so only in Darjiling (Scully 1888). Thomas's (1923) "Bhotan" refers to the "Bhutan Duars" of the Bombay Natural History Society's Mammal Survey which is to be identified with the present Jalpaiguri District of northern West Bengal and not with the sovereign State of Bhutan.

TABL

EXTERNAL AND SKULL-MEASUREMENTS (IN MILLIMETRES) OF

Sl. No.	Coll. No./ Regd. No.	Collector & Date of collection	Locality	Sex	*Fa*	*Tl*	*E*	*Tr*	*Tb*	*F&Cl*
1.	ZFMF —	— 27 Sep 1946	Kuatun, Fukien, China	♂	48.0					
2.	MCZ 14206	— 3 Jan 1912	Lao-kai, Tonkin, Viet-nam	♂	44.0					
3.	RMNH 14984	M. Bartels 21 Apr 1935	Mount Pangrango, northeast of Mount Géde, western Java	♂	45.6			7.0	19.5	11.0
4.	RMNH 15324	M. Bartels 29 May 1934	Tjigoenoeng river, south of Mount Géde, western Java	♂						
5.	BM(NH) 4.4.27.1	H. Hampton —	Mogok, northern Burma	♀	54.0	46.0	19.0			
6.	RMNH 13472	J. D. Pasteur — Oct 1891	Mount Géde, western Java	♀	48.5	47.0		8.5	22.0	10.0
7.	USNM 154681	— —	Buitenzorg, Java	♀	48.0					
8.	BM(NH) —	— —	Java	♀	49.5					
9.	BM(NH) —	— —	-do-	♀	50.0					
10.	BM(NH) —	— —	-do-	♀	50.5					
11.	USNM —	Owen Bryant Expedition to Java, 1909	Buitenzorg, Java	?	49.0					
12.	RMNH 13470	S. Müller 1826-1836	Southeastern side of Mount Géde, western Java	?	45.0	45.0		7.5	20.0	11.0
13.	RMNH 13471	-do-	-do-	?	49.5				21.5	12.0

TABLE 1

EXTERNAL AND SKULL-MEASUREMENTS (IN MILLIMETRES) OF INDIAN EXAMPLES OF *Harpiocephalus harpia* (TEMMINCK)

Sl. No.	Coll. No./ Regd. No.	Collector & Date of collection	Locality	Sex	*Fa*	*Tl*	*E*	*Tr*	*Tb*	*F&Cl*	III^m	III^1	*l*	*cbl*	*ccl*	*pl*	$c\text{-}m^3$	*c-c*	$m^2\text{-}m^2$	*zw*	*iw*	*cw*	Remarks
1.	ZSI 106A	Purchased 1851	Darjiling, Darjiling District, West Bengal	♂	45.0						44.0	18.2					6.5	6.8	7.1				*Vespertilio pearsonii* (Horsfield) of Blyth (1863)
2.	ZSI 18107	W. S. Atkinson 1872	–do–	♂	47.5		15.2	9.6	22.1	9.7	45.3	19.7	21.8	19.0	18.7	8.9	6.6	6.8	7.2	13.7	5.7	10.0	
3.	BNHS 2610	F. Wall 28 Oct 1908	–do–	♂		42.0	18.0																
4.	HNHM Coll. No. 321	G. Topal 12 Apr 1967	Ghoom, Darjiling District	♂	48.7	46.0	17.8	10.9	22.1				22.1	19.2			7.0	6.7		13.6	5.7	10.0	
5.	ZSI 7512	Purchased (E. Barlow) After 1881	Karsiyang, Darjiling District	♂	46.5		16.6	9.1	21.4	8.4	43.7	18.4	21.4	18.8	18.1	8.6	6.8	6.7	7.4	13.3	5.5	9.8	
6.	BNHS 2611	E. A. D'Abreu — Sep 1908	–do–	♂		43.0	17.0																
7.	BM(NH) —	— —	Himalayas	♂	45.5																		*ex* Thomas (1923)
8.	BNHS 2612	H. V. O'Donel 30 Oct 1913	Bhutan Duars = Jalpaiguri District, West Bengal	♂		43.2	16.5																
9.	ZSI SVM/24	S. S. Saha 23 Jan 1980	Silent Valley, Palghat District, Kerala	♂	44.7	40.0	15.7	10.6	20.5	11.4	42.0	19.0	21.5	19.0	18.4	8.8	6.7	6.1	7.2	13.1	5.5	9.5	
10.	ZSI 18106	H. H. Godwin-Austen/1868	Cherrapunji, Meghalaya	♀	50.3		18.0	10.8	21.9	10.1	49.7	22.9	22.9	20.5	20.0	9.4	7.3	7.0	7.9	14.5	5.9	10.7	
11.	ZSI 20218	P. R. MacLaren 25 May 1946	Rivers Tackchom/ Ro Ro, Sikkim	♀	46.6				19.3	10.7	46.4	20.5	22.5	19.9	19.7	8.6	7.0	6.9	7.4	14.5	5.5	10.0	
12.	BM(NH) —	— —	Himalayas	?♀	50.7																		*ex* Thomas (1923)
13.	BNHS 2607	C. Primrose 6 Oct 1915	Karsiyang	♀	48.2	51.0																	
14.	BNHS 2608	–do– 30 Sep 1915	–do–	♀	51.0	51.0																	
15.	ZSI 7513	Purchased (E. Barlow)/After 1881	–do–	♀	51.3		17.2	9.5	23.5	9.7	48.6	20.6	22.5	20.0	19.5	9.0	7.2	7.1	7.6	14.4	5.5	9.7	
16.	BNHS 2606	C. Primrose 17 Aug 1916	Teesta Valley Tea Estate, Darjiling District	♀	51.0	48.0	17.0																
17.	BNHS 2609	–do– 23 Aug 1916	–do–	♀	50.0	50.0	15.0																
18.	BM(NH) 23.1.8.1	C. McCann 29 Mar 1922	Perumal, Palni Hills, Madurai District, Tamil Nadu	♀	53.5	49.0	17.0				51.0	22.0											*ex* Thomas (1923), holotype of *madrassius*
19.	BM(NH) —	— —	Malabar coast, Kerala	♀	52.0																		*ex* Thomas (1923)
20.	BM(NH) 79.11.21.119	B. H. Hodgson —	Central Hills = Darjiling	?	44.3	44.3	17.4																*ex* Hodgson (1847) and Wroughton (1918), holotype of *lasyura*
21.	MCZ 32973	—	Darjiling	?	48.0												7.0						*ex* Tate (1941)

TABLE 2

EXTERNAL AND SKULL-MEASUREMENTS (IN MILLIMETRES) OF NON-INDIAN EXAMPLES OF *Harpiocephalus harpia* (TEMMINCK)

Sl. No.	Coll. No./ Regd. No.	Collector & Date of collection	Locality	Sex	*Fa*	*Tl*	*E*	*Tr*	*Tb*	*F&Cl*	III^m	III^1	*l*	*cbl*	*ccl*	*pl*	$c\text{-}m^3$	*c-c*	$m^2\text{-}m^2$	*zw*	*iw*	*cw*	Remarks
1.	ZFMF —	— 27 Sep 1946	Kuatun, Fukien, China	♂	48.0									19.6						13.8			*ex* Lehmann (1955)
2.	MCZ 14206	— 3 Jan 1912	Lao-kai, Tonkin, Viet-nam	♂	44.0						43.5	18.0		18.5		10.2	6.4			13.2	5.7		*ex* Allen (1913), holotype of *rufulus*
3.	RMNH 14984	M. Bartels 21 Apr 1935	Mount Pangrango, northeast of Mount Gède, western Java	♂	45.6			7.0	19.5	11.0	45.5	19.0	21.3	19.8	18.9	11.5	6.9	6.6	7.3	13.3	5.7	10.1	*ex* Husson (1955), topotype of *harpia*
4.	RMNH 15324	M. Bartels 29 May 1934	Tjigoenoeng river, south of Mount Gède, western Java	♂									21.6	19.4	18.8	11.1	6.7	6.6	7.3	13.5	5.6	9.6	–do–
5.	BM(NH) 4.4.27.1	H. Hampton —	Mogok, northern Burma	♀	54.0	46.0	19.0				50.0	23.5	23.6			10.8		7.3		14.6			*ex* Thomas (1923), holotype of *mordax*
6.	RMNH 13472	J. D. Pasteur — Oct 1891	Mount Gède, western Java	♀	48.5	47.0		8.5	22.0	10.0	48.0	20.5	21.4	19.7	19.1	11.7	6.8	6.7	7.3	13.1	5.3	9.2	*ex* Husson (1955), topotype of *harpia*
7.	USNM 154681	— —	Buitenzorg, Java	♀	48.0										19.0		7.0	6.7	7.3	13.5	5.6		*ex* Tate (1941), near topotype of *harpia*
8.	BM(NH) —	— —	Java	♀	49.5																		*ex* Thomas (1923)
9.	BM(NH) —	— —	–do–	♀	50.0																		–do–
10.	BM(NH) —	— —	–do–	♀	50.5																		–do–
11.	USNM —	Owen Bryant Expedition to Java, 1909	Buitenzorg, Java	?	49.0						48.0	21.0		19.0		11.2	6.9			13.6	5.7		*ex* Allen (1913)
12.	RMNH 13470	S. Müller 1826-1836	Southeastern side of Mount Gède, western Java	?	45.0	45.0		7.5	20.0	11.0	43.5	18.5	20.4	18.8	18.3	11.0	6.7	6.2	7.2	13.1	5.5	9.5	*ex* Husson (1955), lectotype of *harpia*
13.	RMNH 13471	–do–	–do–	?	49.5				21.5	12.0	47.5	22.5					6.8	6.5	7.3	13.6	5.6		*ex* Husson (1955), paralectotype of *harpia*

2

ON-INDIAN EXAMPLES OF *Harpiocephalus harpia* (TEMMINCK)

III^{m}	III^{1}	*l*	*cbl*	*ccl*	*pl*	c-m^{3}	*c -c*	m^{2}-m^{2}	*zw*	*iw*	*cw*	Remarks
			19.6						13.8			*ex* Lehmann (1955)
43.5	18.0		18.5		10.2	6.4			13.2	5.7		*ex* Allen (1913), holotype of *rufulus*
45.5	19.0	21.3	19.8	18.9	11.5	6.9	6.6	7.3	13.3	5.7	10.1	*ex* Husson (1955), topotype of *harpia*
		21.6	19.4	18.8	11.1	6.7	6.6	7.3	13.5	5.6	9.6	–do–
50.0	23.5	23.6			10.8		7.3		14.6			*ex* Thomas (1923), holotype of *mordax*
48.0	20.5	21.4	19.7	19.1	11.7	6.8	6.7	7.3	13.1	5.3	9.2	*ex* Husson (1955), topotype of *harpia*
				19.0		7.0	6.7	7.3	13.5	5.6		*ex* Tate (1941), near topotype of *harpia*
												ex Thomas (1923)
												–do–
												–do–
48.0	21.0		19.0		11.2	6.9			13.6	5.7		*ex* Allen (1913)
43.5	18.5	20.4	18.8	18.3	11.0	6.7	6.2	7.2	13.1	5.5	9.5	*ex* Husson (1955), lectotype of *harpia*
47.5	22.5					6.8	6.5	7.3	13.6	5.6		*ex* Husson (1955), paralectotype of *harpia*

Notes on the biology of *Harpiocephalus harpia* (Temminck)

The massive and well-ossified skull with robust teeth of *Harpiocephalus harpia* indicate that these bats must be feeding on insects with harder body-parts. In fact, Dobson (1876) found remnants of such insects in one stomach examined by him. Unfortunately, the stomach of the specimen from the Silent Valley was empty when it was netted at about 20.00 hours. This example was caught near a pool of water in a clearing in the valley, either side of which was covered with tall trees. The male specimen from Ghoom, Darjiling District, West Bengal, was netted at 18.37 hours in the valley of a small stream. This species is essentially a montane one. Most of the specimens were caught in hilly areas between 1000 and 2000 metres or above. It has, however, also been collected in the Duars of northern West Bengal (30th October) and from the Malabar coast, Kerala. They might possibly also move to lower elevations during winter months. One specimen present in the collection of the Bombay Natural History Society (BNHS No. 2612) was taken roosting among the leaves of a "Luchi" tree. Thus, Walker *et al.*'s (1964) contention that they possibly roost among vegetation appears true.

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Abbreviations used in Tables 1 and 2

COLLECTIONS (Alphabetically):

BM (NH) = British Museum (Natural History), London, U.K.
BNHS = Bombay Natural History Society, Bombay, India.
HNHM = Hungarian Natural History Museum, Budapest, Hungary.
MCZ = Museum of Comparative Zoology, Cambridge, Massachusetts, U.S.A.
RMNH = Rijksmuseum van Natuurlijke Historie, Leiden, The Netherlands.
USNM = U. S. National Museum (=National Museum of Natural History), Smithsonian Institution, Washington, D.C., U.S.A.
ZFMK = Zoologisches Forschungsinstitut und Museum Alexander Koenig, Bonn, F. R. G.
ZSI = Zoological Survey of India, Calcutta, India

MEASUREMENTS (as per sequence):

Fa = length of forearm
Tl = „ „ tail
E = „ „ ear
Tr = „ „ tragus
Tb = „ „ tibia
F & Cl = length of foot and claw
III^m = length of metacarpal of the third finger
III^1 = length of first phalanx of the third finger
l = greatest length of the skull
cbl = condylobasal length
ccl = condylocanine length
pl = palatal length
$c\text{-}m^3$ = length of maxillary tooth-row
c-c = external (cingulum) distance between canines of the upper jaw
$m^2\text{-}m^2$ = external (cusp) distance between second molars of the upper jaw
zw = zygomatic width
iw = least interorbital width
cw = cranial width

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SIZE- AND SEX-DEPENDENT SOCIAL INTERACTIONS OF THE LESSER BANDICOOT RAT, *BANDICOTA BENGALENSIS*[1]

SHAKUNTALA SRIDHARA[2]

(*With five plates*)

Experiments were carried out on the behavioural interaction of equal and unequal sized male-male, male-female and female-female pairs of *Bandicota bengalensis* in neutral cages. The elements of behaviour have been briefly described and are classified into non-social, amicable, agonistic and sexual behaviour. The results show that adult *B. bengalensis* are highly intolerant, with females as aggressive as males. One male was always dominant over the other. Male-male aggression was higher compared to other two pairs. Amicability and increasing body weight showed an inverse relationship. Larger males and females dominated smaller ones.

INTRODUCTION

The lesser bandicoot rat, *Bandicota bengalensis* has been considered as a field or rural rat (Ellerman 1961), causing heavy damage to grain in cultivated fields (Roy 1974) and warehouses (Spillett 1968). However, since 1900 it has become a major component of urban rodent population in India (Deoras 1963, Spillett 1968) and Burma (Harrison 1949). The high inter- and intra-species aggressive activity of this species is considered as the major cause for its successful urban invasion (Spillett 1968). Collias (1944) also regards intra-species strife as one of the stimulants for species spread to new geographic regions. Since information available on the intra-species interactions of *B. bengalensis* is scanty (Spillett 1968, Frantz 1973, Sridhara, Narasimhan and Krishnamoorthy 1980), this paper records the behavioral components of *B. bengalensis* in detail as observed during paired encounters in neutral cages. Attempts are also made to measure the influence of sex and size of the partner on amicable and agonistic behaviour.

MATERIALS AND METHODS

The rats were caught by digging out burrows in paddy (*Oryza sativa*) fields around Bangalore. At the laboratory, they were acclimatised for a fortnight by maintaining them in galvanised iron mesh cages (35 × 35 × 50 cm), with a nest box (10 × 12 × 19 cm) on one side containing cotton for bedding. They were fed on rat and mouse feed (Hindustan Lever, India). Water was supplied ad libitum. Lighting regime was 12 h light (1800-0600 h) and 12 h darkness (0600-1800 h). Room temperature varied at 23 ± 4°C.

Encounters between different pairs were staged in a 100 x 50 x 50 cm observation chamber. It had a galvanised sheet back, glass sides and front, and wire mesh top. A sliding

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partition made of galvanised sheet divided the chamber into two equal parts. The glass sides were also of sliding type facilitating easy introduction of animals.

All interactions were studied between 1000 h and 1200 h to avoid diurnal fluctuations of activity. For each encounter, two animals were placed on either side of the partition and left for five minutes to allow them to settle down. The partition was then slowly removed and the ensuing encounter observed for 10 minutes and their behaviour noted down.

The first set of experiments was designed to study the effect of size on the amicable and agonistic behaviour of equal sized male-male, male-female and female-female pairs. Four weight regimes in the increasing order under each category of pairs were observed (Table 1), with four replications being carried out under each size.

TABLE 1

SEX COMBINATIONS STUDIED AND THEIR WEIGHTS

	Equal sized pairs				Unequal sized pairs			
I	Male-1	vs	Male-2	I	larger male	vs	smaller male	Weight diff.
	150 ± 1.1		150 ± 0.92		258 ± 1.05		208 ± 0.76	50
	170 ± 1.03		170 ± 0.85		250 ± 0.58		180 ± 0.81	70
	200 ± 0.83		200 ± 1.46		260 ± 1.53		170 ± 1.24	90
	260 ± 1.83		260 ± 1.31		245 ± 0.94		145 ± 0.86	100
II	Male	vs	Female	II	larger male	vs	smaller female	Weight diff.
	100 ± 1.04		100 ± 0.79		170 ± 1.21		140 ± 0.88	30
	150 ± 1.2		150 ± 1.18		194 ± 0.95		134 ± 1.14	60
	170 ± 0.87		170 ± 0.91		214 ± 1.83		114 ± 1.16	100
	200 ± 0.73		200 ± 1.34		266 ± 2.05		160 ± 0.93	106
III	Female-1	vs	Female-2	III	smaller male	vs	larger female	Weight diff.
	100 ± 0.67		100 ± 1.22		170 ± 0.84		190 ± 1.81	20
	140 ± 1.21		140 ± 1.33		154 ± 1.06		204 ± 0.93	50
	170 ± 1.05		170 ± 0.91		105 ± 0.95		205 ± 0.81	100
	200 ± 0.76		200 ± 1.33		100 ± 1.02		260 ± 0.95	160
				IV	larger female	vs	smaller female	Weight diff.
					214 ± 2.33		184 ± 1.41	30
					190 ± 1.85		130 ± 1.14	60
					186 ± 1.63		106 ± 1.25	80
					206 ± 0.88		106 ± 1.26	100

Figures represent weight in g ± S.E.

In the second set of experiments the effect of increasing weight difference between the pair members on behaviour was studied. Four types of pairs were used, namely larger male *versus* smaller male, larger male *versus* smaller female, smaller male *versus* larger female and larger female *versus* smaller female; four replications were tried under each type.

A total of 168 animals (84 males and 84

non-pregnant females) in the weight range of 100-266 g were utilized. No attempt was made to determine the estrous conditions of the experimental females.

Based on the descriptions of Grant & Mackintosh (1963), Ewer (1971), Barnett (1975) and Begg & Nelson (1977), the various 'Postures' (Static position, Grant & Mackintosh 1963) and 'acts' (behaviour involving movement, Grant & Mackintosh 1963) of *B. bengalensis* behaviour were identified; whenever deviations occurred, descriptions were given. Of the whole range of behaviour elements only the frequency of occurrence of amicable behaviour (Nosing, allogrooming and huddling) and agonistic behaviour (Threat, crawling over/under, lunge, chase, attack, fight, boxing, bite, submissive posture and flight were considered for statistical comparisons between the sexes and sizes.

The mean and standard error of amicable and agonistic behaviour counts were computed. To assign amicable/agonistic status to either of the sex, student 't' test was conducted. For establishing influence of size on the behaviour Spearman-rank correlation tests were conducted assigning ranks to weights and behaviour scores from which rs was computed (Siegel 1956). Kruskal-Wallis one way analysis of variance was carried out to establish amicable and agonistic order of the three sex combinations studied (Siegel 1956).

RESULTS

BEHAVIOURAL COMPONENTS AND THEIR CLASSIFICATION

Non-social behaviour. Exploring involved walking, running, jumping, climbing, scratching, digging, sniffing, handling and gnawing objects. These acts help to perceive the sensory input from the surroundings.

Grooming consisted of several acts which help in cleaning the body surface. These included scratching, licking, wiping, nibbling, combing the body surface and face (plate I, 1).

Amicable behaviour. Approach is any directed movement towards another animal (Begg & Nelson 1977).

Nose-nose while approaching each other, two rats touch each other's nose and sniff, with the body in *stretched attention posture* (Plate I, 2).

Nosing is touching the fur or body surface of the opponent with the nose.

Ano-genital sniffing. The ano-genital region of one rat (mostly female) is sniffed by another rat, a male in majority of the cases.

Huddling. Crouching of two rats with their bodies in close contact. The behaviour, though well established for laboratory and feral Norway rats, *Rattus rattus* (Barnett 1958), and *Rattus villosissimus* (Begg & Nelson 1977), was not seen in paired encounters of *B. bengalensis.*

Allogrooming is grooming or nibbling the fur or combing with the forepaws of one rat by another.

Agonistic behaviour: Approach. If the two rats were of equal social status, the animals moved towards each other with body fully extended, held low to the ground; tail remained stiff and horizontally raised. Eyes and ears were focussed on the opponent (Plate I, 2). Plate II, 3 and 4 demonstrate the approach act of a dominant rat towards a subordinate.

Displacement activities are those acts which seem to have no relevance to the behavioural situation in which they take place. These include *displacement grooming* which consists of wiping the face with forepaws. During *displacement digging* the ground is scratched or any material or object is pushed with the help of legs. Often rats *mark* the cage floor with the whole or part of the ventral body surface. Of these only displacement grooming and marking were displayed by *B. bengalensis.*

Push-past. The act involved the dominant animal pushing between the wall of the cage and a crouching submissive rat.

Crawling under. A submissive rat crawls slowly beneath the body of its aggressive opponent with its dorsal surface in contact with the latter's ventral side. Crawling under may be between fore- and hindlimbs or just beneath the other rat's head. Such complete act of crawling under was not seen in *R. villosissimus* (Begg & Nelson 1977), instead crawling under consisted of resting one rat's head below the other's head or abdomen. A similar posture was displayed by *B. bengalensis* (Plate III, 5).

Crawling over: The approaching rat typically walks over the head/dorsal surface of another rat. Both *R. villosissimus* and *B. bengalensis* restrict the act only to placing the head over another rat's head or dorsal surface (Begg & Nelson 1977) (Plate III, 6).

Piloerection is raising body hairs erect and indicates the social status of confronting rats. If the two rats are equally matched, both exhibit piloerection (Plate III, 6), but in unequally matched pairs, it is displayed only by the dominant rat (Plate II, 3; Plate III, 5; Plate IV, 7, 8; Plate V, 9, 10).

Offensive sideways posture. To start with, all the four feet of the dominant rat will be on the ground freely extended. The body is arched accompanied by piloerection. The subordinate rat will be usually crouched in a corner of the cage (Plate III, 5). The aggressive rat moves side ways, pushing the submissive to a corner of the cage (Plate IV, 7).

Defensive sideways posture. The defending rat usually crouches in a corner of the cage. It tries to prevent the attack with its forelimbs. Its head will be twisted towards the attacker (Plate IV, 7).

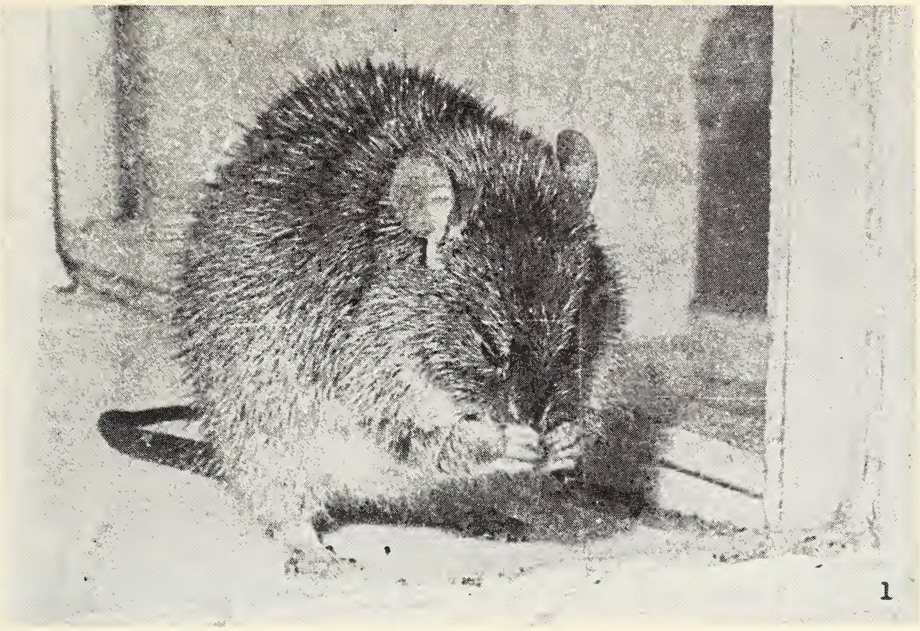
Offensive and defensive upright posture. Normally both the rats assumed this posture simultaneously, standing erect on hindlimbs and tail, presenting the ventral side to each other. They may remain still with forepaws touching or hold the forepaws of each other resulting in the 'Boxing' posture (Plate V, 10).

Fleeing is running and escaping from the opponent.

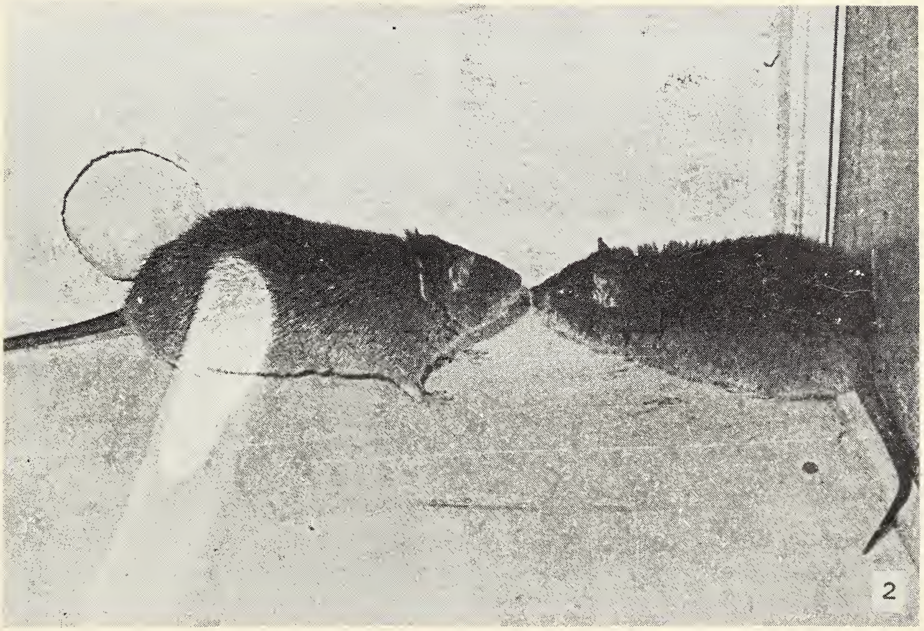
Chasing is running after the fleeing rat.

Leap. Often the more aggressive rat leaps on another rat prior to exhibiting the *Offensive sideways posture* or while chasing the fleeing rat (Plate V, 9).

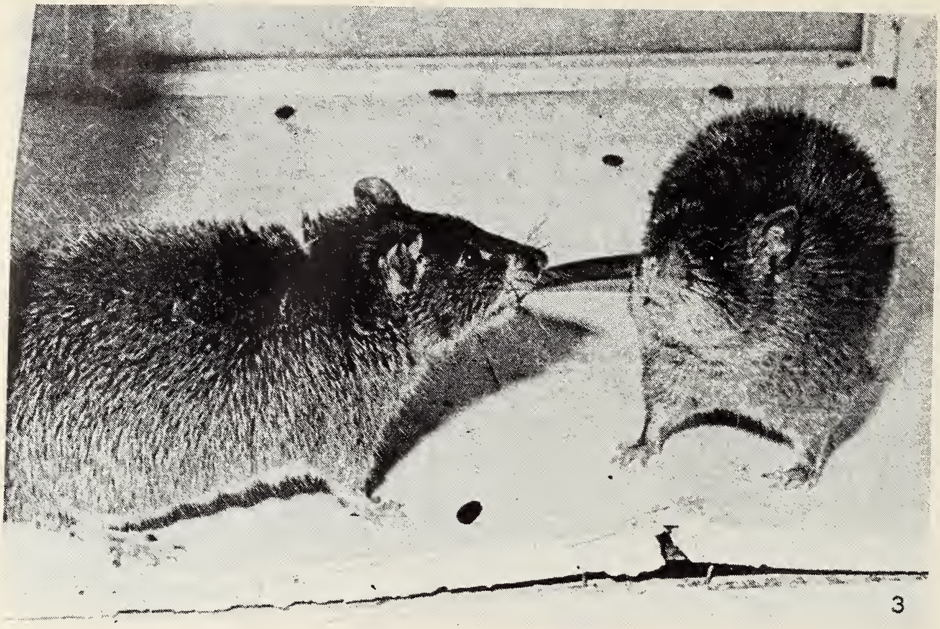
Submissive posture. The term seems to involve slightly different descriptions. Rather different species of rodents seem to display slightly varied postures, the aim being to prevent attack by the dominant conspecific. The act consists of lying down on the side with eyes closed, usually displayed during approach by a dominant rat (Barnett 1975). In contrast Begg & Nelson (1977) describe that an animal facing a severe attack, suddenly lies on its side or back with all the four limbs in the air with eyes closed. The head may be twisted towards the attacker and mouth open. Squealing accompanies this act. In the woodmouse, *Apodemus sylvaticus*, the animal is on its hindlimbs, head lifted, ears held back, eyes half closed and the forepaws are tucked in (Gurnell 1977). The submissive posture of *B. bengalensis* seems to closely resemble this. The rat stands on its hindlimbs



Grooming.



Approach by two equal status rats.
(*Photos*: S.H. Sridhara)



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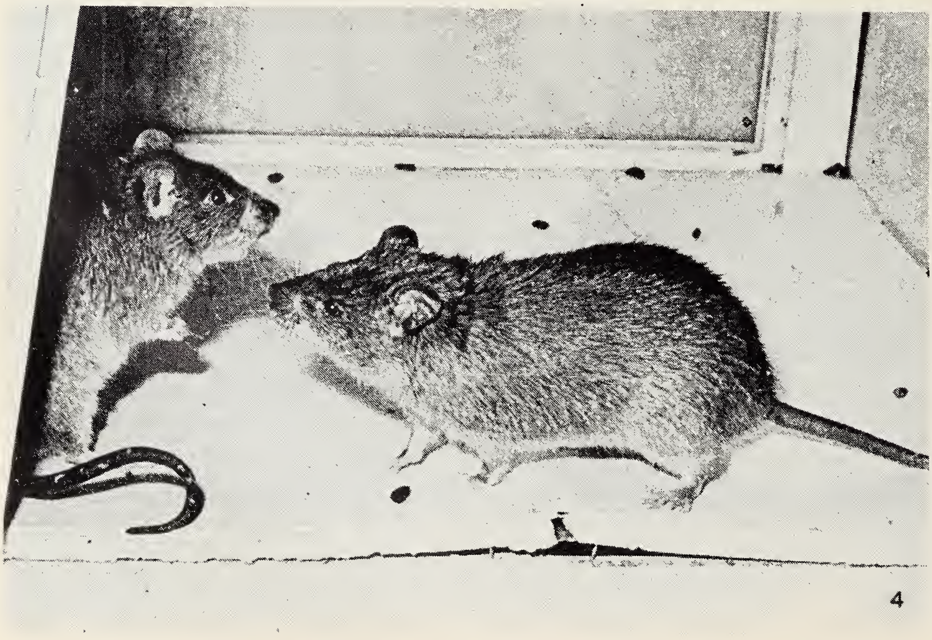
Approach by submissive rat on left, *offensive sideways* posture on right.



4

Defensive upright posture on left, approach by dominant on right.
(*Photos*: S.H. Sridhara)

with forelimbs withdrawn but eyes are kept open (Plate IV, 8). The posture is accompanied by squealing. The act helped to ward off attack both during approach of the dominant rat and in the middle of a fight.

Crouching. The animal bends its back, draws up the body holding it low, usually in a corner of the cage.

Sexual activities. Beach's (1966) description of sexual activities encompasses acts like following: *Attempted mount, mount, intromission, ejaculation, post-copulatory groom* and *lordosis.* Ano-genital sniffing can also be included under this. *B. bengalensis* in cages exhibited only following: *Ano-genital sniffing* and *attempted mount.*

Temporal sequence of activity. The sequential occurrence of responses during intraspecies encounter of *R. villosissimus* were broadly divided into three arbitrary phases which graded into each other (Begg & Nelson 1977). The behaviour of *B. bengalensis* in paired encounters closely resembles these phases, which can be briefly described thus:

Phase 1. The initial 2-3 minutes of an encounter were characterised by highest agonistic behaviour and the establishment of dominant-subordinate relationships. In equally matched male pairs cautious approach by the two males was the first act. This was followed by nose-nose, sniffing each other or offensive sideways/offensive upright posture by both or sudden leap, attack boxing, fleeing and chasing. The boxing posture was displayed for 30-40 seconds, then one of the rats broke off, assumed a submissive posture and started squealing. In unequal male pairs, at the approach of the dominant rat itself the subordinate assumed a submissive posture accompanied by squealing. The dominant rat displayed offensive sideways posture or attacked the submissive animal. In male-female encounters similar sequence of activities took place but fights were mostly preceded by ano-genital sniffing by both sexes more often by the male. Female tended to attack the male whenever the latter tried to sniff her genital region or tried to mount her. In female-female interactions initial approach and fighting took place for a very short duration, i.e. within a minute.

Phase 2. The offensive and defensive acts and postures continued but at a relatively low intensity in male and male-female confrontation. Displacement activities were exhibited by both dominant and submissive rats.

Phase 3. There was more or less complete cessation of agonistic behaviour. Non-aggressive acts like crouching by the subordinate in a corner, exploring by the dominant initially, later by the submissive and grooming by both occurred.

Influence of sex on amicable and agonistic behaviour. Amicable behaviour was seen in equal measures in male-male and male-female encounters and was least in female-female interactions ($H = 5.41$, $P < 0.049$, Kruskal-Wallis one way analysis of variance), implying more contact behaviour in the two former pairs. Male-male confrontations were characterised by highest agonistic behaviour followed by male-female and female-female interactions ($H=11.31$, $P < 0.008$, Kruskal-Wallis one way analysis of variance).

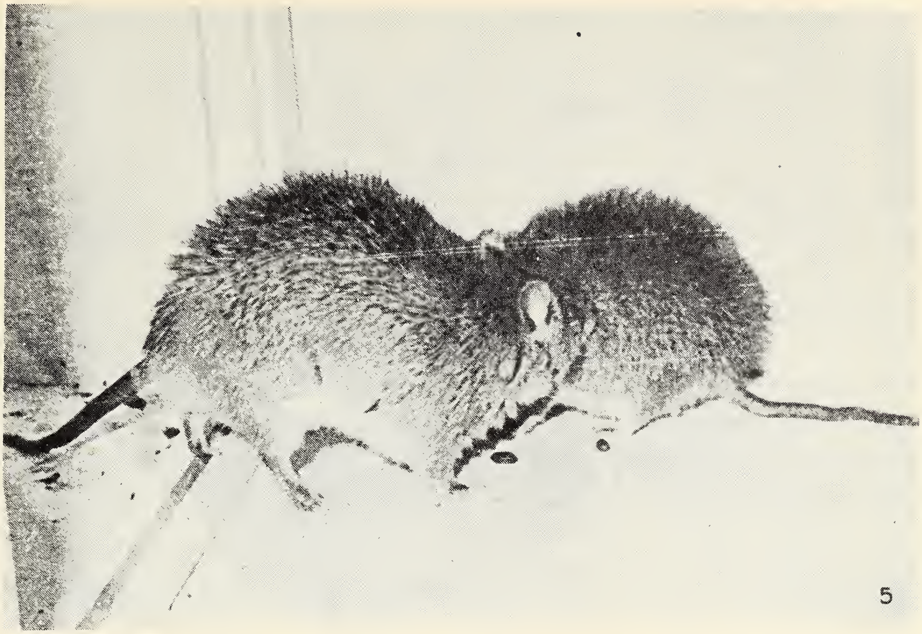
Influence of size on amicable behaviour. In equal sized male-male interactions, one male was more amicable ($P < 0.02$ and 0.001; Table 2) whereas in female-female and male-female encounters of same size category both were equally amicable except at 100 g weight level where one of the females in the former case and the female in the latter case exhibited more amicability ($P < 0.001$, Table 2: $P < 0.02$, Table 3). Amicable behaviour

TABLE 2

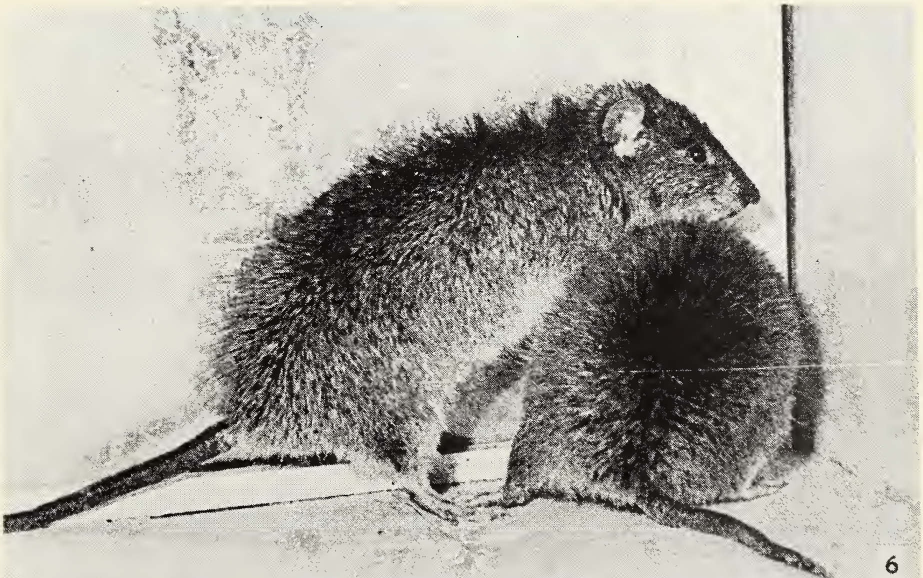
AMICABLE AND AGONISTIC BEHAVIOUR SCORES OF MALE-MALE AND MALE-FEMALE PAIRS OF *B. bengalensis*

Sex of the pair	Counts of	Equal sized pairs			Unequal sized pairs		
		male/female	male/female	P <	larger/larger male/female	smaller/smaller male/female	P <
I Male vs Male	Amicable behaviour	2.00±0.75	23.62±2.62	0.001	1.33±0.27	8.67±0.72	0.001
		4.33±1.09	13.66±2.59	0.02	0.67±0.15	9.33±1.96	0.02
		3.66±0.72	9.33±0.72	0.001	1.33±0.27	10.67±0.72	0.001
		2.66±0.27	8.33±1.44	0.02	2.67±0.27	17.33±1.91	0.001
	Agonistic behaviour	2.00±0.82	—	0.05	11.66±1.51	3.33±0.54	0.01
		13.00±0.47	15.00±1.67	0.05	43.33±4.57	21.67±2.12	0.02
		10.67±1.78	34.00±2.49	0.001	42.66±2.23	17.33±1.44	0.001
		21.00±0.67	25.00±0.82	0.02	10.33±0.72	3.67±0.54	0.001
II Female vs Female	Amicable behaviour	28.00±1.63	8.00±1.41	0.001	1.00±0.47	4.00±0.47	0.05
		16.00±2.62	8.00±1.63	0.05	—	2.00±0.94	0.05
		9.33±1.44	9.67±1.44	0.05	2.00±0.47	12.00±1.41	0.001
		2.33±0.54	1.67±0.54	0.05	2.33±0.27	16.67±1.94	0.001
	Agonistic behaviour	2.33±0.27	7.67±1.48	0.02	36.00±2.35	9.00±0.94	0.001
		5.33±0.98	11.67±1.19	0.02	36.33±3.14	7.67±1.19	0.001
		4.33±1.91	6.67±1.96	0.05	17.33±0.98	5.66±0.98	0.001
		2.00±3.27	4.00±2.24	0.05	5.00±0.94	—	0.01

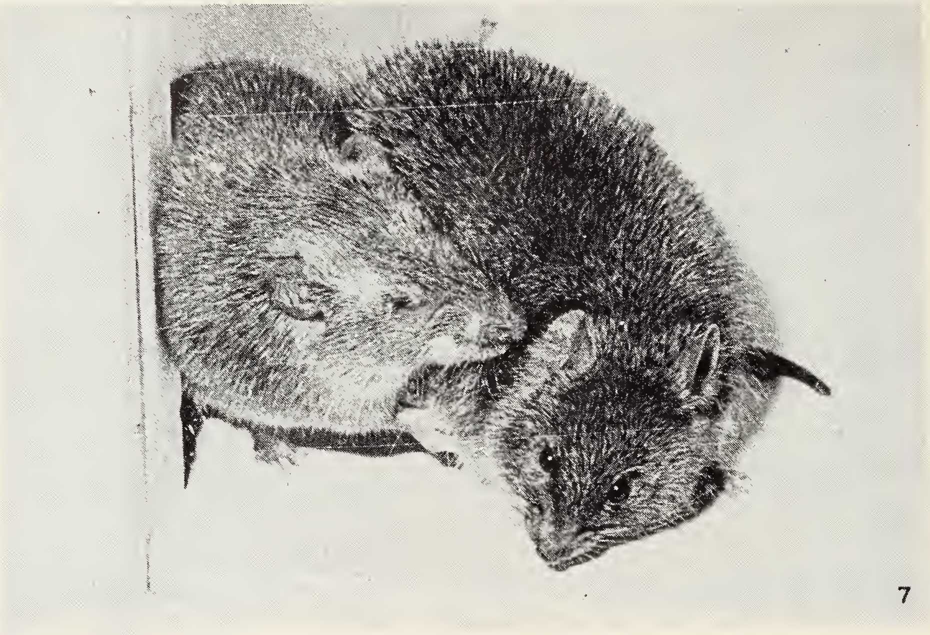
PLATE III



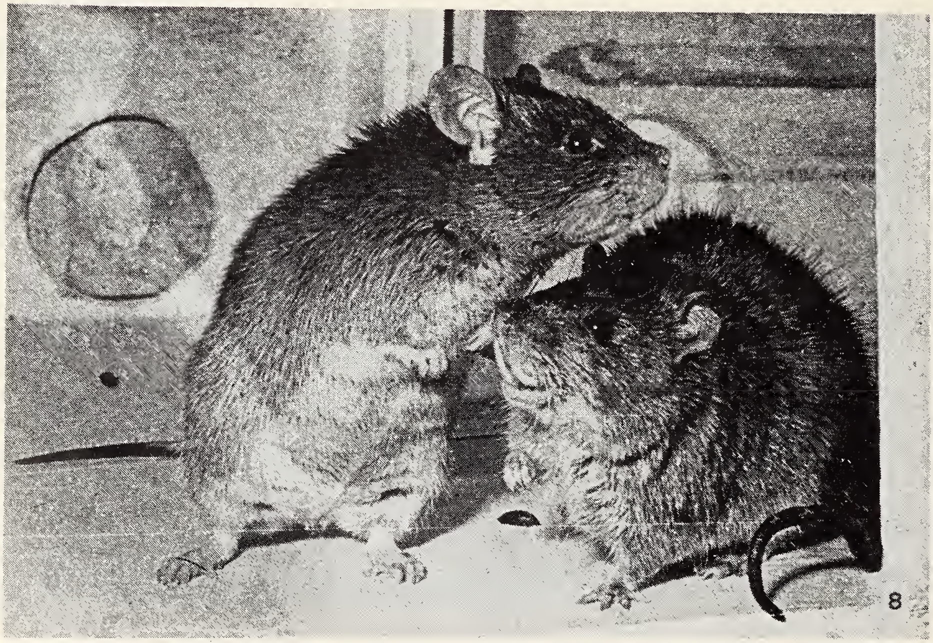
Crawling under by the right rat (submissive).



Crawling over by the left rat (dominant rat).
(*Photos*: S.H. Sridhara)



Defensive sideway posture on left, *offensive sideway posture* on right.



Submissive posture on left, approach by dominant on right.
(*Photos*: S.H. Sridhara)

TABLE 3

AMICABLE AND AGONISTIC BEHAVIOUR COUNTS OF HETEROSEXUAL PAIRS OF *B. bengalensis*

Counts of	Equal sized pairs			Unequal sized pairs					
	Male	Female	P <	larger male	smaller female	P <	smaller male	larger female	P <
Amicable behaviour	10.67 ± 1.44	17.33 ± 1.44	0.02	3.67 ± 0.54	13.33 ± 1.00	0.001	10.00 ± 1.25	2.00 ± 0.47	0.001
	10.67 ± 0.54	16.33 ± 2.33	0.05	2.00 ± 0.75	10.00 ± 1.47	0.02	2.67 ± 0.52	1.33 ± 0.27	0.05
	10.33 ± 1.19	15.67 ± 1.91	0.05	0.33 ± 0.33	0.66 ± 0.36	0.05	1.00 ± 0.47	2.00 ± 0.67	0.05
	3.67 ± 0.98	8.33 ± 1.36	0.05	1.33 ± 0.22	1.67 ± 0.46	0.05	2.67 ± 0.54	3.33 ± 0.72	0.05
Agonistic behaviour	—	—	—	1.00 ± 0.7	—	0.05	—	—	—
	—	—	—	—	—	—	—	—	—
	—	—	—	6.00 ± 0.47	5.00 ± 1.25	0.05	—	—	—
	21.33 ± 1.66	22.33 ± 2.09	0.05	8.00 ± 0.94	6.00 ± 0.81	0.05	—	—	—

decreased as the weight of the pairs increased in all the equal sized pairs combinations studied (N=4, r_s = 1.0, p = 0.05). In unequally matched male-male pairs, smaller member was always more amicable (P < 0.02 and 0.02, Table 2); in female-female and male-female pairs of differently weighing partners, the smaller members exhibited higher amicable behaviour counts only when the weight difference was 80 and 100 g in female pairs (P < 0.001, Table 2) and 30 g and 60 g in larger male *versus* smaller female (P < 0.001 and 0.02, Table 3) and 20 g in smaller male *v.* larger female encounters (P < 0.001, Table 3). Amicability decreased as the weight difference between the pair members increased in the latter two types of sex-size combinations (N = 4, r_s = 1.0, P = 0.05).

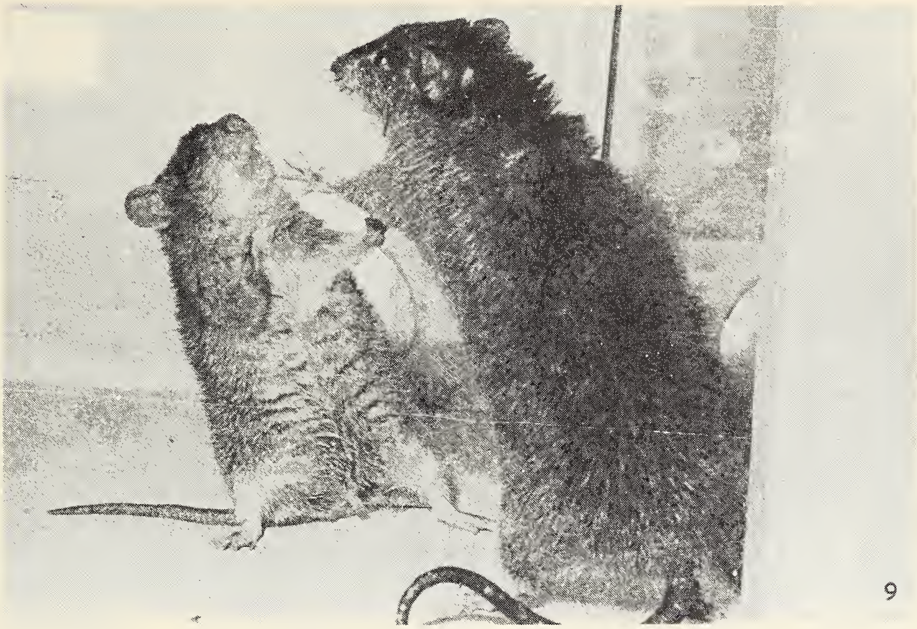
Influence of size on agonistic behaviour. In equal sized male-male pairs significant difference in agonistic behaviour between pair members was seen only in large sized, i.e. above 200 g weighing pairs (P < 0.001 and 0.02, Table 2) while in female-female pairs aggression was limited to smaller sized, i.e. less than 140 g weighing pairs (P < 0.02, Table 2). No agonistic behaviour was evident in equal sized heterosexual pairs except in 200 g weighing pairs, wherein both the sexes were equally aggressive (P < 0.05, Table 3). Larger male *versus* smaller female interactions were characterised by low levels of agonistic behaviour with no differences in the behaviour of two sexes (P < 0.05, Table 3). The interactions between smaller male and larger female were without any aggressive displays. In unequally sized male-male and female-female interactions, the heavier member was more aggressive (P < 0.02 and 0.001, P < 0.001 and 0.01 respectively, Table 2). Weight difference between the pairs did not bear any relation to agonistic behaviour in equally sized pairs whereas in unequally matched pairs increasing weight difference between pair members in female-female combinations was inversely related to agonistic behaviour ($N=4$, $r_s=1.0$, $P=0.05$).

Sexual behaviour. Very little sexual activities were observed during the entire period of observation. It was limited to smaller/equal sized male sniffing the anogenital region of the female and following. In all such attempts females aggressively threatened the males, sometimes even attacked them.

DISCUSSION

Intraspecies aggression in vertebrates is mainly due to territorial defence and/or establishment of social heirarchies. In the present context as the animals were introduced simultaneously into the two halves of the neutral cage followed by observation of their interactions, it can be presumed that conflict arose to establish social status than to defend territory. The study of Parrack and Thomas (1970) on the behaviour of *B. bengalensis* suggested the presence of a larger, dominant, aggressive male which lost weight thus showing the characters of Barnett's (1975) *alpha* as well as *omega* and a subordinate male which was continuously harassed by the former, moved slowly, lost weight but survived, thus resembling both *beta* and *omega.* But this conclusion has to be viewed with reservation as the study was based on observation of only two males and two females in a pen. It is not either possible to establish any social heirarchy based on the present results of paired encounters although emergence of one male as more aggressive and dominant in equal sized pairs (above 200 g weighing) as well as larger male's constant dominance over smaller ones indicates the existence of *alpha* males in *B. bengalensis* as in *R. norvegicus.* The species also resembles *R. rattus* in that the adult females (above 200 g weight range) are as belligerent as males (Ewer 1971). Since the larger males were always aggressive towards smaller ones, the dispersal of young male *B. bengalensis* could be caused by adult male's aggression as in majority of rodents.

Reports as to which sex is more aggressive during intraspecific strife suggest a species specific dominance by either sex or both as equally aggressive. Amongst laboratory mice and woodmice, *Apodemes sylvaticus*, males are more agonistic (Tollmann & King 1956, Valzelli 1969, Gurnell 1977). Females were more aggressive and dominated males amongst Mongolian gerbils (Swanson 1974) and hamsters (Payne & Swanson 1970). Most early observations recorded only male aggression amongst rats. Both Barnett (1958) and Calhoun (1962) failed to observe conflict between females or between males and females of *Rattus norvegicus*; later studies of Ewer (1971) on *R. rattus* and of Barnett & Stewart (1975) on *R. fuscipes* showed females to be more aggressive. Agonistic behaviour of equal magnitude was displayed by the two sexes in *R. villosissimus* (Begg & Nelson 1977). In *B. bengalensis* male-male aggression is far more than what is seen between male-female and female-female encounters but intersex aggression is dependent on size. Confrontation between large female and smaller male, and in equal sized male-female pairs weighing less than 200 g were devoid of aggression. In the few instances of intersexual conflict, i.e. above 200 g weighing but pairs having equal sized members there was no discernible qualitative difference in the agonistic behaviour of the two sexes. This lack of display of dominance of females by males could be due to an inherent inhibition to attack female which is common in a number of species, including rats irrespective of females's capacity to be



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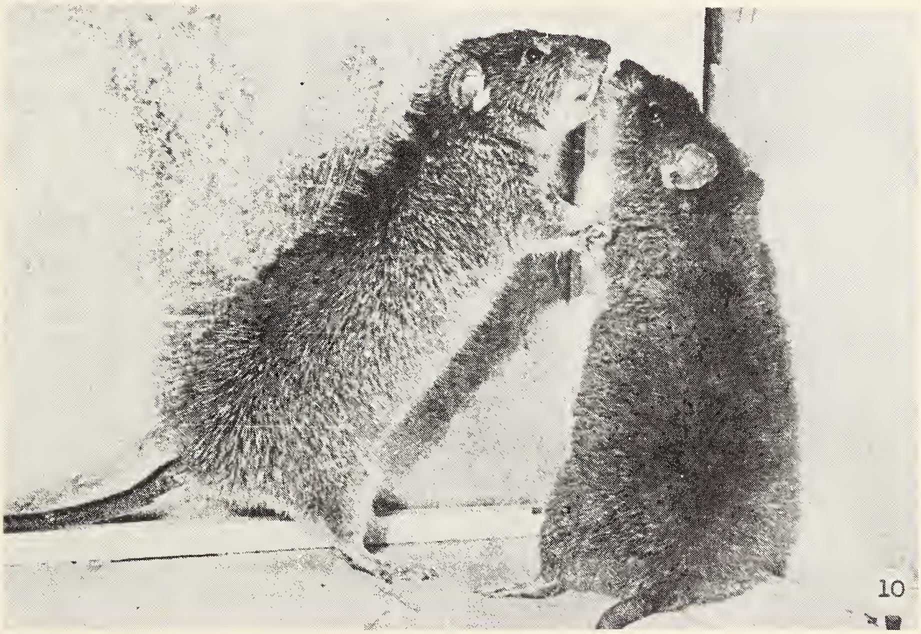
Defensive upright on left, *leap* and *attack* on right.



10

Boxing.
(*Photos*: S.H. Sridhara)

agonistic (Moyer 1972, Begg & Nelson 1977). On the other hand the female's tendency to be equally aggressive may affect successful mating of the two sexes. Collias (1944) pointed out that excessive aggressiveness towards the opposite sex is probably an obstacle to mating and female dominance over male inhibited mating in monkeys (Maslow 1936) and chicken (Schjelderup-Ebbe 1935). While designing techniques to breed Mongolian gerbils, Marston (1972) suggested that greater care should be taken to minimise fighting. Studies of Swanson (1974) showed that although males always sniffed and pursued the females, the latter threatened the males and did not allow intromission suggesting that aggression towards strangers is stronger than sexual drive. The behaviour of adult. *B. bengalensis* in heterosexual interaction was exactly the same which could be the reason why it is highly difficult to breed *B. bengalensis* in the laboratory. The solitary existence of the species in nature unlike other murids could also be due to female's belligerance.

Body size is another factor which is known to determine aggressive success in hamsters (Payne & Swanson 1970), mice (Ginsberg & Allee 1942), woodmice (Andrzelewski & Olszewski 1963) and rats (Barnett 1958, Calhoun 1962). Barnett (1958) observed well grown *R. norvegicus* males to be dominant over other males and *alpha* males were always heavier than colony members. Similarly Calhoun (1962) found that in colonies of *R. norvegicus* winners weighed heavier than the colony mean weight and losers weighed obviously less. Begg (1976) also reports a highly significant correlation between mean body weight and aggressive rankings in *R. villosissimus.* However, Baenninger (1970) and Boice (1972) found little relationship between these two viables. Tests on wild and domestic *R. norvegicus* of similar age indicated that such a correspondence between the two factors existed only when stock differences in body weight were greatest (Boreman & Price 1972). The present observations clearly indicate that body weight influences both amicable and aggressive behaviour of lesser bandicoots. While in equally matched male pairs, one male was always more amicable, one established himself as more dominant only at higher weight ranges. In unequally weighing male and female pairs, the smaller was always more amicable and the larger invariably the aggressor. In pairs of equally weighing rats, amicability decreased as animal weights increased but such relationship between amicable behaviour and weight difference between pair members in unequally weighing combinations was seen only in male-female and female-female pairs. Agonistic behaviour was absent in intersex pairs consisting of equally matched male-females below 200 g weight range and in those combinations involving smaller males.

The description of behaviour presented in this paper is exhaustive but the evaluation of social behaviour is by no means conclusive. Including the present observations the information available on the social behaviour of *B. bengalensis* is inadequate. Further work on natural and confined populations need to be carried out to understand its social organization. Nevertheless, the results obtained here indicate high levels of aggression amongst adult pairs, as well as the influence of body weight on such encounters.

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I am grateful to late Dr. K. Ramakrishnan (Dean) and Dr. R. Naryana (Director of Instruction, BS&H) of University of Agricultural Sciences, Bangalore for facilities and encouragement. Financial aid of Ford Foundation (Grant No. 660-0109), New Delhi is acknowledged.

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SPECIES OF CEROPLASTINAE (HOMOPTERA: COCCIDAE) FROM INDIA[1]

RAJENDRA KUMAR AVASTHI
AND
S. ADAM SHAFEE[2]

(*With four text-figures*)

Brief review of the subfamily Ceroplastinae is given. Key to Indian genera of Ceroplastinae, and separate keys to Indian species of the genera *Ceroplastes* Gray and *Cerostegia* De Lotto are provided. Descriptions and illustrations of three species of *Ceroplastes* Gray [*C. alami* sp. nov., *C. ceriferus* (Fabricius), *C. pseudoceriferus* Green] and one species of *Vinsonia* Signoret [*V. stellifera* (Westwood)] are given. Material deposited in Zoological Museum, Aligarh Muslim University, Aligarh, India.

Subfamily CEROPLASTINAE Signoret

Ceroplastaria Signoret, 1872b: 423.

Ceroplastinae Signoret; Bodenheimer, 1952: 317.

Ceroplastiinae Signoret; Bodenheimer, 1953: 93.

Signoret (1872b) proposed Ceroplastaria as subsection under the section Lecanites. Atkinson (1886) recognized Ceroplastaria as subdivision under the subfamily Lecanina. Bodenheimer (1952) raised Ceroplastaria to the rank of subfamily Ceroplastinae in the family Coccidae. The subfamily status of Ceroplastinae has been accepted by Borchsenius (1957) and Ali (1971). Giliomee (1967) has shown the affinity of *Ceroplastes* Gray with *Coccus* Linnaeus on the basis of the study of adult males. Further, he suggested the synonymy of the subfamily name Ceroplastinae with Coccinae of the family Coccidae. Williams (1969) credited the authorship of this group name to Maskell instead of Signoret. Recently, Koteja (1974) suppressed the subfamily Ceroplastinae and assigned its genus *Ceroplastes* under Coccini Fallen. In the present study Ceroplastinae is recognized as subfamily in the family Coccidae and it is credited to Signoret. The subfamily is represented by four genera from India which are separated by the following key characters:

KEY TO INDIAN GENERA OF CEROPLASTINAE SIGNORET, BASED ON ADULT FEMALES

1. Stigmatic spines extending along the margin of the stigmatic clefts 2
— Stigmatic spines never extending along the margin of the stigmatic clefts 3
2. Ventral tubular ducts, when present, with inner ductule rather long and more slender than outer one (figs. 1-3; De Lotto, 1965: figs. 2-4; 1971: figs. 1-2 & 5; Williams & Kosztarab, 1972: pls. 4 & 6 .... *Ceroplastes* Gray, 1828
— Ventral tubular ducts with inner ductule short and as wide or wider than the outer one (De Lotto, 1969: figs. 1-3; Ben-Dov, 1970: fig. 1; Williams & Kosztarab, 1972: pl. 5; Avasthi & Shafee, 1979: fig. H & I) ....*Cerostegia* De Lotto, 1969

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3. Stigmatic spines numerous, arranged in a group and extending on dorsum at right angles to the margin; tibia and tarsus separate (De Lotto, 1965: figs. 6-12); waxy covering of body never star-shaped . . .. *Gascardia* Targioni-Tozzetti, 1893
— Stigmatic spines few, confined to the cleft; tibia and tarsus fused together (fig. 4; De Lotto, 1965: fig. 23); waxy covering of body star-shaped... .... *Vinsonia* Signoret, 1872a.

1. Genus *Ceroplastes* Gray

Ceroplastes Gray, 1828: 7.
Type-species: *Coccus* (*Ceroplastes*) *janeirensis* Gray, 1828 (by subsequent designation).

Gray (1828) proposed *Ceroplastes* as subgenus of *Coccus* Linnaeus for the species: *Coccus* (*Ceroplastes*) *janeirensis* and *C.* (*C.*) *chilensis.* Later, the subgenus was raised to the generic rank by Vigor (1829). De Lotto (1965, 1971) recognized the genera, *Columnea* Targioni-Tozzetti, *Lacca* Signoret and *Baccacoccus* Brain as subjective synonyms of *Ceroplastes* Gray. Ali (1971) catalogued five species of *Ceroplastes* from India, of which *Ceroplastes floridensis* (Comstock) was earlier shifted by De Lotto (1969) under his genus *Cerostegia.* At present the genus is represented by five species including one new species from India. A key for the separation of Indian species of *Ceroplastes* is given below.

KEY TO INDIAN SPECIES OF *Ceroplastes* GRAY, BASED ON ADULT FEMALES*

1. Legs well developed with tibia and tarsus separate 2
— Legs very small with tibia and tarsus fused together; stigmatic spines hemispherical (Zimmerman, 1948: fig. 174) ....*C. rubens* Maskell
2. Legs without tibio-tarsal articulatory sclerosis; claws without denticle; dorsal setae long and cylindrical 3
— Legs with tibio-tarsal articulatory sclerosis; claws with denticle; dorsal setae small and never cylindrical; anal plate each with long and slender setae dorsally (fig. 1) .... *C. alami* sp. nov.
3. Multilocular pores present near fore coxae; marginal setae arranged close to each other; anal lobe each with 9 long setae (fig. 3) .... *C. pseudoceriferus* Green
— Multilocular pores absent near fore coxae; marginal setae widely spaced; anal lobe each with 5 long setae (fig. 2; De Lotto, 1971: figs. 1 & 2; Williams & Kosztarab, 1972: pl. 4) .... *C. ceriferus* (Fabricius)

* *Ceroplastes actiniformis* Green is not incorporated in the key due to its inadequate original description.

Ceroplastes alami sp. nov.
(Fig. 1 A-N)

Adult female (fig. A): Mounted specimens broadly oval in shape, less than one and a half times longer than wide (2.52:1.76 mm). Dorsum with membranous processes which are devoid of pores and setae; dorsal setae (fig. C) small and thick with bluntly pointed and truncated apices, sparsely distributed; bi- and trilocular pores (fig. D) present. Marginal setae (fig. B) simple and curved, few straight, widely spaced, 3 long simple setae present on each anal lobe. Stigmatic clefts shallow, each with 22-27 small, thick and conical spines (fig. G), arranged in a linear row along the margin of the stigmatic clefts, single large conical spine present on mid of each cleft. Caudal process strongly sclerotized. Anal plates (fig. E) together slightly longer than wide placed at the apex of caudal process, anterolateral margins much shorter than posterolateral margins; each plate with 1 apical, 1 subdiscal and 1 discal long and slender setae dorsally, 2 long subapical setae ventrally; anal fold with 4 pairs of small fringe setae.

Venter with few small and thin setae (fig. M)

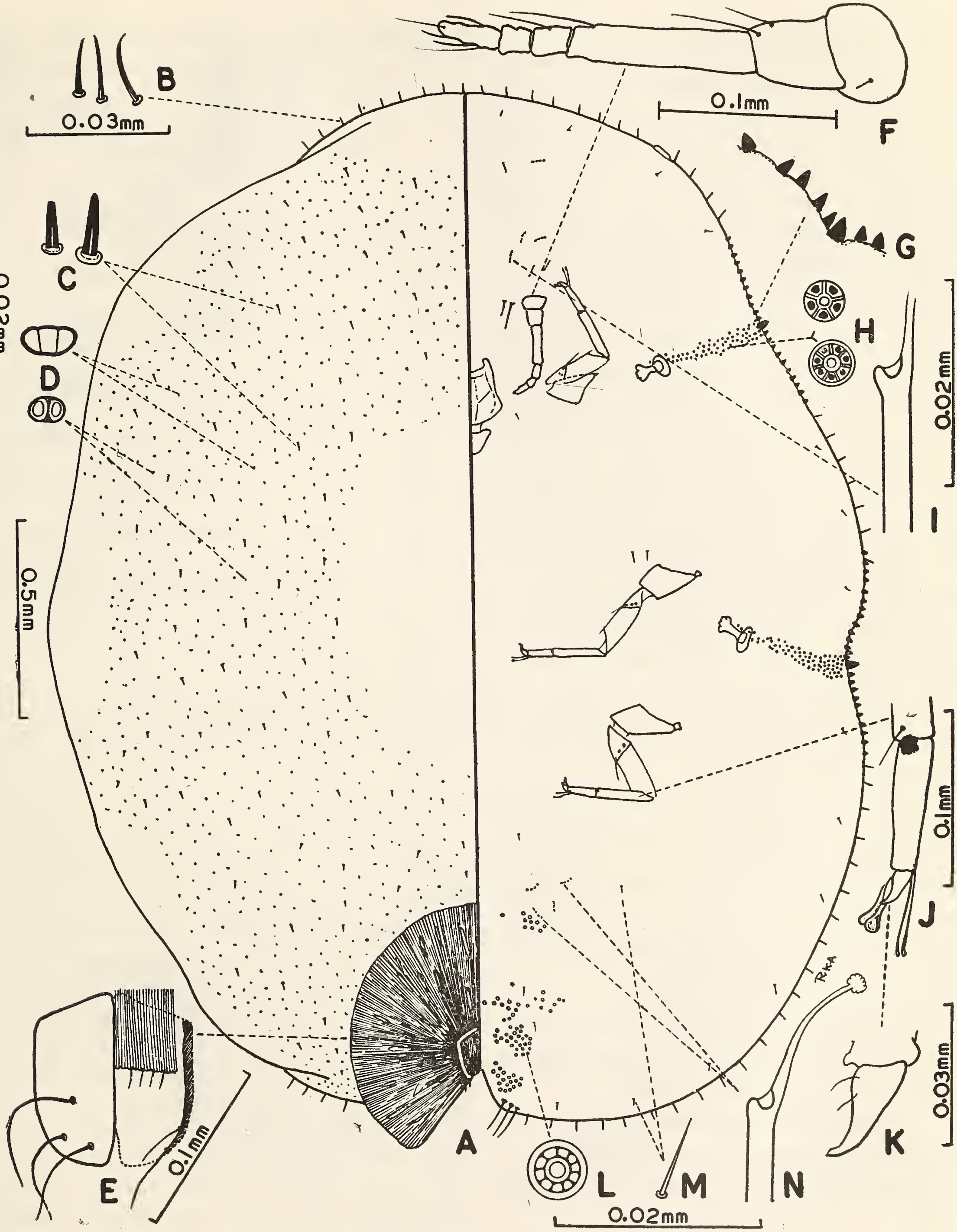
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Fig. 1. A-N. *Ceroplastes alami* sp. nov., ♀.

on submarginal and median areas; 2 pairs of interantennal setae of variable lengths present, prevulvar setae absent. Pores with 5-7 locules (fig. H) arranged in a band between spiracles and stigmatic clefts. Multilocular pores (fig. L) in groups around genital opening and near anal lobes. Tubular ducts (figs. I, N) with inner ductule more slender than outer one, confined to cephalic and abdominal regions medially. Eyes present. Antennae (fig. F) 6-segmented, 0.26 mm in length; segment 3rd longest, about 5 times longer than wide. Rostrum monomerous. Spiracles small. Legs well developed with tibio-tarsal articulatory sclerosis (fig. J); claws with a small denticle at apices (fig. K), digitules longer than claw and clubbed at apices; tarsal digitules slender, clubbed at apices; dimensions of fore, mid and hind legs: trochanter + femur (0.15: 0.17: 0.18 mm), tibia (0.12: 0.12: 0.12 mm) and tarsus (0.07: 0.07: 0.07 mm) respectively.

Holotype ♀. INDIA: Tamil Nadu, Coimbatore, Mettupalaiyam, on wild plant, 26.iii.1979 (*R. K. Avasthi*).

Paratypes. 3 ♀, same data as holotype. 6 ♀, Uttar Pradesh, Aligarh, on *Dalbergia sissoo*, 7.vii.1979 (*R. K. Avasthi*).

The new species is closely related to *Ceroplastes toddaliae* Hall and *C. spicatus* Hall. It differs from the former by its having interrupted row of stigmatic spines between anterior and posterior stigmatic clefts; and from the latter by its having reduced number of stigmatic spines, small caudal process, and in the absence of stout spike on wax test.

This species is named after Prof. S. Mashhood Alam, Department of Zoology, Aligarh Muslim University, Aligarh, India.

Ceroplastes actiniformis Green

Ceroplastes actiniformis Green, 1896: 8.
Ceroplastes actiniformis Green; Green, 1930: 281.
Ceroplastes actiniformis Green; Ali, 1971: 15.

This species is known to the authors only by its original description.

Ceroplastes ceriferus (Fabricius)
(Fig. 2 A-M)

Coccus ceriferus Fabricius, 1798: 546.
Coccus chilensis Gray, 1828: 7.
Ceroplastes ceriferus (Fabricius); Walker, 1852: 1087.
Ceroplastes australiae Walker, 1852: 1087.
Columnea cerifera (Fabricius); Targioni-Tozzetti, 1866: 144.
Ceroplastes ceriferus (Anderson); Signoret, 1868: 848.
Lacca alba Signoret, 1868: 848.
Ceroplastes ceriferus (Anderson); Atkinson, 1886: 280.
Ceroplastes ceriferus (Anderson); Fernald, 1903: 149.
Ceroplastes ceriferus (Anderson); Morrison, 1920: 200.
Ceroplastes ceriferus (Anderson); Ayyar, 1930: 39.
Ceroplastes ceriferus (Anderson); Borchsenius, 1957: 457.
Ceroplastes ceriferus (Anderson); Das & Ganguli, 1961: 250.
Gascardia cerifera (Anderson); De Lotto, 1965: 198.
Ceroplastes ceriferus (Anderson); Ali, 1971: 16.
Ceroplastes ceriferus (Fabricius); De Lotto, 1971: 133.
Ceroplastes ceriferus (Fabricius); Williams & Kosztarab, 1972: 36.

Adult female (fig. A): Mounted specimens broadly oval in shape, less than one and a half times longer than wide (2.97: 2.21 mm). Dorsum with membranous processes which are devoid of pores and setae; dorsal setae (fig. B) long, thick and cylindrical, most with blunt and few with swollen apices, sparsely distributed; bi-, tri- and quadrilocular pores (fig. C) present. Marginal setae simple and curved, widely spaced, 5 long simple setae present on each anal lobe. Stigmatic clefts much shallow, each with numerous small, thick and conical spines (figs. D, E) and few extending along the margin of the cleft. Caudal process strongly

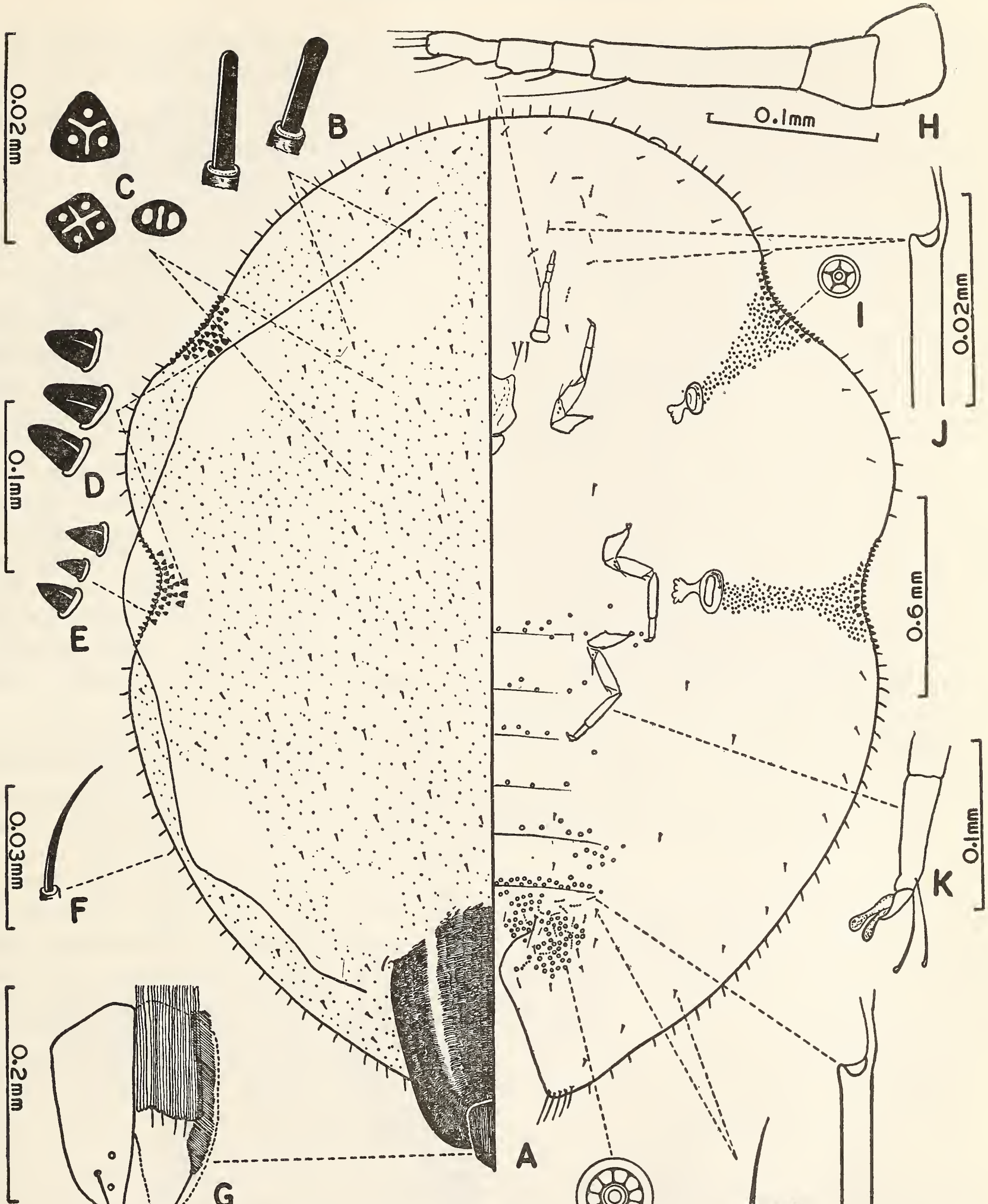
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Fig. 2. A-M. *Ceroplastes ceriferus* (Fabricius), ♀.

sclerotized. Anal plates (fig. G) together longer than wide, placed at the apex of caudal process, anterolateral margins much shorter than posterolateral margins; each plate with 3 apical setae dorsally, 1 long subapical seta ventrally; anal fold with 4 pairs of small fringe setae.

Venter with thin setae (fig. M) arranged in a row submarginally, few scattered irregularly; 3 pairs of interantennal setae of variable lengths and a pair of long prevulvar setae present. Quinquelocular pores (fig. I) in a broad band between spiracles and stigmatic clefts. Multilocular pores (fig. L) numerous around genital opening and few extend medially upto posterior spiracles. Tubular ducts (fig. J) few with inner ductule more slender than outer one, confined to cephalic and genital regions. Eyes present. Antennae (fig. H) 6-segmented, 0.28 mm in length; segment 3rd longest, more than 5 times longer than wide. Rostrum monomerous. Spiracles large. Legs well developed, without tibio-tarsal articulatory sclerosis; claws simple, digitules longer than claw and clubbed at apices; tarsal digitules slender and clubbed at apices (fig. K); dimensions of fore, mid and hind legs: trochanter + femur (0.14: 0.15 : 0.16 mm), tibia (0.1 : 0.1 : 0.1 mm) and tarsus (0.05 : 0.06 : 0.07 mm) respectively.

Material examined: 4 ♀, INDIA: Tamil Nadu, Coimbatore, Forest Research Center Garden, on wild plant, 27.iii.1979; 3 ♀, Vadamadurai, on *Abutilon indicum*, 29.iii.1979 (*R. K. Avasthi*).

Note: The authorship of the species has been discussed in detail by De Lotto (1971).

Ceroplastes pseudoceriferus Green
(Fig. 3 A-N)

Ceroplastes pseudoceriferus Green, 1935: 180.
Ceroplastes pseudoceriferus Green; Green, 1937: 310.
Ceroplastes pseudoceriferus Green; Sankaran, 1962: 1-18.
Ceroplastes pseudoceriferus Green; Ali, 1971: 18.
Ceroplastes pseudoceriferus Green; De Lotto, 1971: 142.

Adult female (fig. A): Mounted specimens broadly oval in shape, less than one and a half times longer than wide (3.57:2.7 mm). Dorsum with membranous processes which are devoid of pores and setae; dorsal setae (fig. E) small, thick and cylindrical with slightly swollen apices, sparsely distributed; bi- and trilocular pores (fig. D) present. Marginal setae (fig. B) simple and curved, few straight, arranged very close to each other, 9 long simple setae present on each anal lobe. Stigmatic clefts much shallow each with numerous small, thick and conical spines, few extending along the margin of the cleft. Caudal process strongly sclerotized. Anal plates (fig. F) together longer than wide placed at the apex of caudal process, anterolateral margins much shorter than posterolateral margins; each plate with 2 apical and 1 discal setae dorsally, 1 small subapical seta ventrally; anal fold with 3 pairs of small fringe setae.

Venter with small thin setae (fig. N) arranged in a row submarginally and few scattered medially; 3 pairs of interantennal setae of variable lengths and a pair of long prevulvar setae present. Quinquelocular pores (fig. I) in a broad band between spiracles and stigmatic clefts. Multilocular pores (fig. M) numerous around genital opening and in transverse rows on preceding abdominal segments, few near each coxae. Tubular ducts (fig. J) few with inner ductule more slender than outer one, confined to cephalic region and around genital opening. Eyes present. Antennae (fig. G) 6-segmented, 0.32 mm in length; segment 3rd longest, less than 6 times longer than wide. Rostrum (fig. H) monomerous. Spiracles normal. Legs well developed, without tibio-tarsal articulatory sclerosis; claws simple, digitules

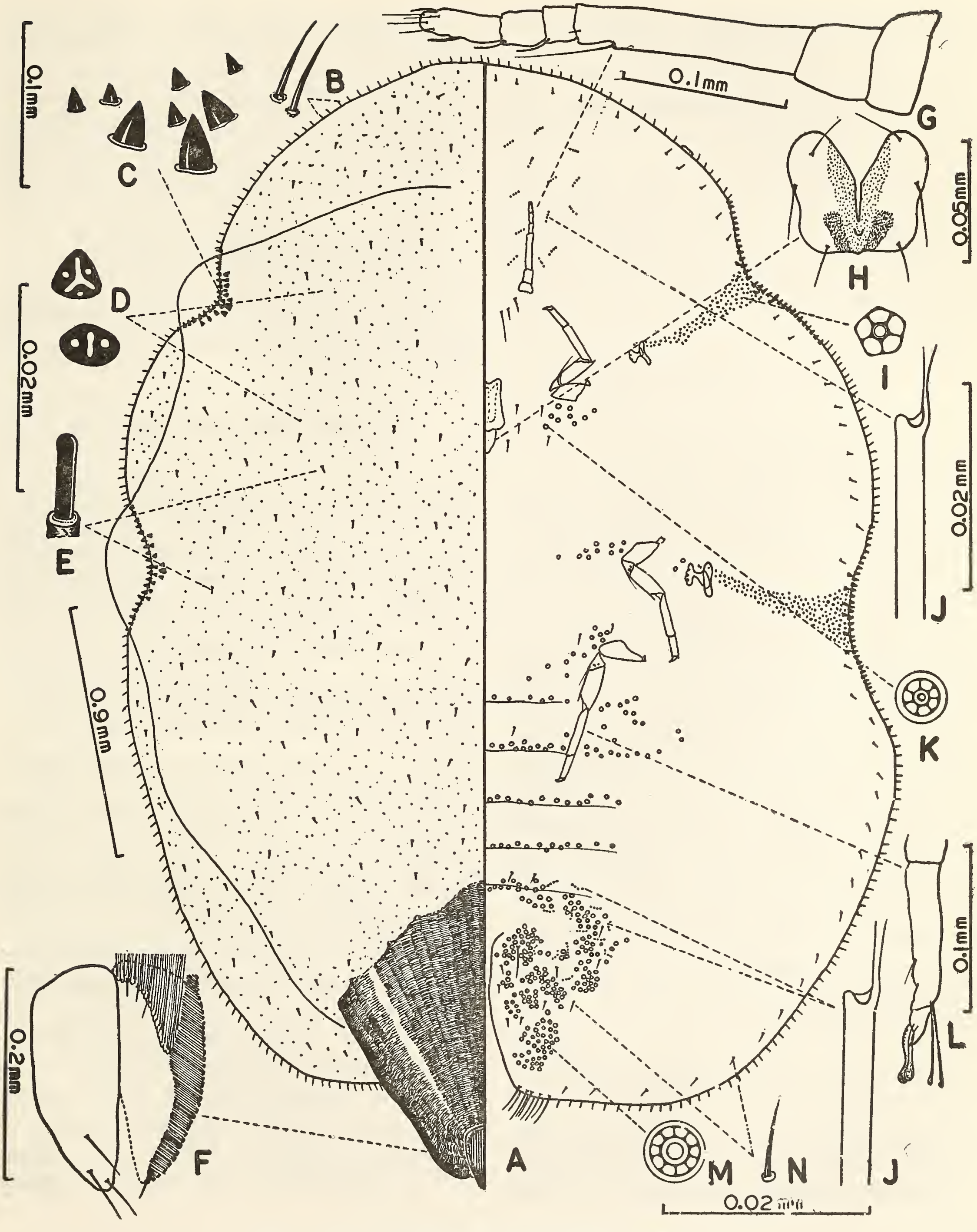
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Fig. 3. A-N. *Ceroplastes pseudoceriferus* Green, ♀.

longer than claw and clubbed at apices; tarsal digitules slender and clubbed at apices (fig. L); dimensions of fore, mid and hind legs: trochanter + femur (0.18:0.18:0.19 mm), tibia (0.13:0.14:0.15 mm) and tarsus (0.07:0.08: 0.08 mm) respectively.

Material examined: 6 ♀, INDIA: Uttar Pradesh, Aligarh, Somna, Govt. Krishi Farm, on *Mangifera indica* Linn., and *Blumea lacera*; 2.v.1977; 3 ♀, Bulandshahar, Danwar, on *Mangifera indica* Linn., 12.v.1977 (*R. K. Avasthi*).

Ceroplastes rubens Maskell

Ceroplastes rubens Maskell, 1893: 214.
Ceroplastes rubens Maskell; Ayyar, 1930: 40.
Ceroplastes rubens Maskell; Zimmerman, 1948: 343.
Ceroplastes rubens Maskell; Das & Ganguli, 1961: 250.
Ceroplastes rubens Maskell; De Lotto, 1965: 187.

The species has been fully redescribed and illustrated by Zimmerman (1948).

2. Genus *Cerostegia* De Lotto

Cerostegia De Lotto, 1969: 211.

Type-species: *Ceroplastes rufus* De Lotto, 1966 (by original designation).

De Lotto (1969) proposed the genus *Cerostegia* for 3 species of the genus *Ceroplastes* Gray (*C. floridensis* Comstock, *C. japonicus* Green and *C. rufus* De Lotto) and designated *C. rufus* De Lotto as its type-species. Very recently, Avasthi & Shafee (1979) described the species *Cerostegia ajmerensis* from India. At present this genus includes 4 species, of which 2 species are known to occur in India. The Indian species are separated by the following key characters.

KEY TO INDIAN SPECIES OF *Cerostegia* DE LOTTO, BASED ON ADULT FEMALES

1. Caudal process reaching just beyond the abdominal apex; anal cleft small, less than twice the length of anal plates; quadrilocular pores present on dorsum; tubular ducts with inner ductule short, one-third the length of outer ductule (De Lotto, 1969: fig. 1)....*C. floridensis* (Comstock)
— Caudal process slightly away from the abdominal apex; anal cleft well developed, more than twice the length of anal plates; quadrilocular pores absent on dorsum; tubular ducts with inner ductule long, slightly shorter than outer ductule (Avasthi & Shafee, 1979: figs. H & I) .... *C. ajmerensis* Avasthi & Shafee

Cerostegia ajmerensis Avasthi & Shafee

Cerostegia ajmerensis Avasthi & Shafee, 1979: 36.

Material examined: 7 ♀, INDIA: Rajasthan, Ajmer, Hathi Bhata, on *Cassia fistula*, 3.ii.1978 (*R. K. Avasthi*).

Cerostegia floridensis (Comstock)

Ceroplastes floridensis Comstock, 1881: 331.
Ceroplastes floridensis Comstock; Green, 1896: 8.
Ceroplastes floridensis Comstock; Fernald, 1903: 152.
Ceroplastes floridensis Comstock; Green, 1908: 43.
Ceroplastes floridensis Comstock; Ayyar, 1930: 40.
Ceroplastes floridensis Comstock; Borchsenius, 1957: 459.
Cerostegia floridensis (Comstock); De Lotto, 1969: 211.
Ceroplastes floridensis Comstock; Ali, 1971: 16.
Cerostegia floridensis (Comstock); Ben-Dov, 1971: 25.
Ceroplastes floridensis Comstock; Williams & Kosztarab, 1972: 43.
Cerostegia floridensis (Comstock); Avasthi & Shafee, 1979: 36.

Material examined: 3 ♀, INDIA: Uttar Pradesh, Aligarh, on *Mangifera indica* Linn., 15.viii.1979 (*R. K. Avasthi*).

3. Genus *Gascardia* Targioni-Tozzetti

Gascardia Targioni-Tozzetti, *in* Gascard, 1893: 88.

Type-species: *Gascardia madagascariensis* Targioni-Tozzetti, 1893 (by monotypy).

Targioni-Tozzetti *in* Gascard (1893) proposed the genus *Gascardia* and placed it close to lac insects. Newstead (1908) and Mamet (1951) independently have shown its affinity with *Ceroplastes* Gray. De Lotto (1965) redefined the genus *Gascardia* and assigned under it the wax scales having the stigmatic spines set in more or less compact groups which extend from the stigmatic clefts towards the dorsum. The genus is represented by a single species from India.

Gascardia destructor (Newstead)

Ceroplastes destructor Newstead, 1917: 26.
Ceroplastes destructor Newstead; Brain, 1920: 28.
Gascardia destructor (Newstead); De Lotto, 1965: 200.
Ceroplastes destructor Newstead; Subba Rao, 1965: 71-75.
Gascardia destructor (Newstead); Hodgson, 1969: 24.

The species has been redescribed in detail by De Lotto (1965). Subba Rao (1965) reported this species from India as host of an encyrtid parasite *Anicetus parvus* Compere.

4. Genus *Vinsonia* Signoret

Vinsonia Signoret, 1872a: 33.
Type-species: (*Vinsonia pulchella* Signoret, 1872) = *Coccus stellifer* Westwood, 1871 (by monotypy).

Signoret (1872a) proposed the genus *Vinsonia* for the species, *Vinsonia pulchella* Signoret. The same author (1877) synonymized his species *V. pulchella* with *Coccus stellifer* Westwood which is generally accepted as type-species of *Vinsonia* Signoret. Lindinger (1913) synonymized *Vinsonia* Signoret with *Ceroplastes* Gray, whereas, Takahashi (1939) suggested its synonymy with *Ceroplastes.* Morrison (1920), Ayyar (1930), Green (1930, 1937), Ghose (1961), De Lotto (1965) and Ali (1971) recognized it as valid genus. The genus is known to contain 2 species, of which *V. stellifera* (Westwood) is known to occur in India.

Vinsonia stellifera (Westwood)
(Fig. 4 A-K)

Coccus stellifer Westwood, 1871: 3.
Vinsonia pulchella Signoret, 1872a: 34.
Coccus stellifera Westwood; Signoret, 1877: 608.
Vinsonia pulchella Signoret; Atkinson, 1886: 279.
Vinsonia stellifera (Westwood); Douglas, 1888: 152.
Vinsonia stellifera (Westwood); Green, 1896: 8.
Vinsonia stellifera (Westwood); Fernald, 1903: 159.
Ceroplastes stellifer (Westwood); Lindinger, 1913: 81.
Vinsonia stellifera (Westwood); Morrison, 1920: 187.
Vinsonia stellifera (Westwood); Ayyar, 1930: 40.
Vinsonia stellifera (Westwood); Green, 1937: 311.
Vinsonia stellifera (Westwood); Ghose, 1961: 67.
Vinsonia stellifera (Westwood); De Lotto, 1965: 234.
Vinsonia stellifera (Westwood); Ali, 1971: 19.

Adult female (fig. A): Mounted specimens broadly oval in shape, slightly longer than wide (1.91 : 1.63 mm); dorsum with poorly developed membranous processes; dorsal setae absent. Bilocular pores (fig. C) with loculi of different diameter sparsely distributed except membranous processes. Marginal setae (fig. E) small, simple and curved, 2 long simple setae present on each anal lobe. Stigmatic clefts well developed, each with a group of 8-10 thick conical spines of variable lengths (figs. B, H). Anal plates (fig. D) together longer than wide, placed at the apex of a slightly elevated and sclerotized caudal process; each plate with 1 apical, 1 subdiscal and 1 discal long setae dorsally, 1 subapical seta ventrally; anal fold with 3 pairs of fringe setae of variable lengths.

Venter with few spinose setae scattered irregularly; 16-18 long and thin interantennal and a pair of long prevulvar setae present. Quinquelocular pores (fig. G) in a band between spiracles and stigmatic clefts. Multilocular pores (fig. I) few around genital opening and on anal lobes. Minute tubular ducts (fig. J) scattered irregularly. Eyes absent. Antennae (fig. F) short, 6-segmented, 0.15 mm in length;

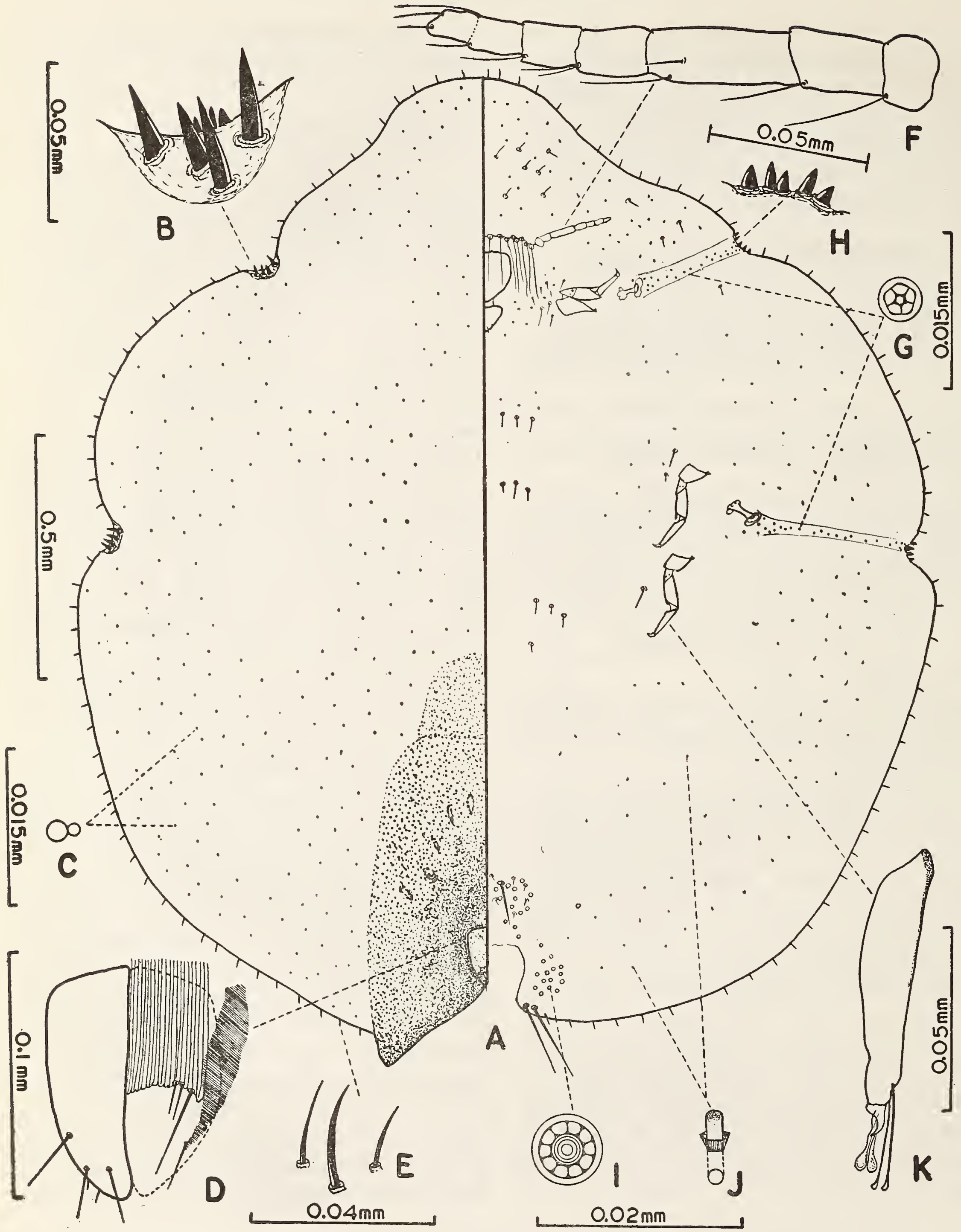
0.05mm
B
F
0.05mm
H
G
0.015mm
0.5mm
0.015mm
C
0.1 mm
D
E
A
I
J
K
0.05mm
0.04mm
0.02mm

Fig. 4. A-K. *Vinsonia stellifera* (Westwood), ♀.

segment 3rd longest, slightly less than 3 times as long as wide. Legs small, tibia and tarsus fused together (fig. K); claws simple, digitules longer than claw and clubbed at apices; tarsal digitules slender, knobbed at apices; dimensions of fore, mid and hind legs: trochanter + femur (0.08 : 0.08 : 0.08 mm) and tibia + tarsus (0.06:0.06: 0.06 mm) respectively.

Material examined: 3 ♀, INDIA: Kerala, Kottayam, on *Syzygium cuminii*, 2.iv.1979 (*R. K. Avasthi*).

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A CATALOGUE OF THE BIRDS IN THE COLLECTION OF BOMBAY NATURAL HISTORY SOCIETY — 31

Muscicapidae (Sylviinae) (Contd.)

Humayun Abdulali

[*Continued from Vol. 83*(1): 163]

This part deals with 682 specimens of the genera *Phylloscopus, Seicercus, Abroscopus, Regulus* and *Leptopoecile* of 70 species and subspecies.

The Genus *Phylloscopus*

Many of the specimens were obtained during the first quarter of the century and are much faded and in poor condition. However, the species/subspecies is marked on many labels by CBT (Dr. C. B. Ticehurst) presumably when preparing his Systematic Review of the Genus *Phylloscopus* (1938) and by Whistler, Meinertzhagen and other collectors when handling fresh skins. This has greatly assisted the sorting of this difficult group. A fair series has been received from the British Museum (N.H.) for comparison and I am grateful to Mr. Peter Colston for his continuous assistance.

Dr. (Mrs.) S. Unnithan has assisted with the work and it is curious that the first skin we handled resulted in the detection of a bird wrongly identified as *Phylloscopus trochilus acredula* and its removal from the Indian avifauna.

(1572) EL. **Phylloscopus trochilus acredula** (Linnaeus) (Uppsala, Sweden) Northern Leaf Warbler

1 subad. ♂ *Village Pidmi, R. Svir, Leningrad Region, U.S.S.R.*

The note in *JBNHS* (Vol. 83: 209) indicates that the single specimen on which this was included in the Indian avifauna had been wrongly identified and the subspecies is now removed from the Indian list.

Measurements on p. 350.

1573 **Phylloscopus trochilus yakutensis** Ticehurst (Verkhoiansk dist., Yakut Land) Siberian Leaf Warbler

nil.

EL. **Phylloscopus trochilus trochilus** (Linnaeus) (England, south of the Thames) Willow Warbler

1 ♀ *Basra, Iraq.*

The bird was identified by Mr. Colston at British Museum (N.H.)

Measurements on p. 350.

1574 **Phylloscopus collybita collybita** (Vieillot) (Normandy, France) Chiffchaff

13: 4 ♂♂ 4 ♀♀ 5 o?

1 *Tortoli, Sardaigne, France*; 3 *Sheikh Saad*, 2 *Aquar-Quf, Baghdad*; 1 *Hawi Plain, N. of Samarra*, 1 *Feluja, R. Euphrates*, 1 *Shatt-el-Adhain*, 1 *Nahr Umar, R. Tigris*, nr. *Basra, Iraq*; 2 *Shiraz*, 1 *Shustan, South Persia.*

Meinertzhagen and Ticehurst identified one bird obtained at Quetta on 28th July as of this form and this is the only record from our area.

Measurements on p. 350.

1575 **Phylloscopus collybita tristis** Blyth (Calcutta) Brown Chiffchaff 2:456

51: 18♂♂ 19 ♀♀ 14 o?

1 *Kazimain*, 1 *Baghdad, Iraq*; 1 *Shiraz, Iran*, 1 *Tanb I., Persian Gulf*; 2 Kohat, 3 Wana, N.W.F.P., 2 Quetta, Baluchistan; 3 Pithoro, 1 Phulji, Sind; 1 Karindeva, 5 Ambala, 1 Ladwal, Karnal, Punjab; 1 Keonthal, 5 Simla; 1 Pushkun, Ladakh; 1 Delhi; 1 Bhung, 1 Bahawalnagar, 2 Harunabad, Bahawalpur; 1 Hamavas Lake, 1 Tilwara, Jodhpur; 2 Baretha, 1 Bharatpur; 1 Surwaya, Gwalior, C.I.; 1 Kharaghoda, 1 Waghjipur, Mehsana, 1 Bhavnagar, 1 Cambay City environs, 1 Ajwa, Baroda; 3 Madhmeshwar, Nasik, Maharashtra; 1 N. Kanara; 1 Manzaul, Bihar; 1 Partapur, Nepal.

The brown, green and yellow in the plumage is barely visible and most of these are identified in accordance with the note under the genus.

Some of them have visibly larger bills than the others but they show no other differences.

Measurements on p. 350.

1576 **Phylloscopus collybita sindianus** Brooks (Sukkur, Sind) Sind Chiffchaff 2:457

5: 2 ♂♂ 2 ♀♀ 1 o?

2 *Birjand, Persia*; 1 Kargil, 1 Dras, Kashmir; 1 *Taghai, Yarkand*.

Measurements on p. 350.

EL. **Phylloscopus collybita abietinus** (Nilsson) (Sweden)

10: 3 ♂♂ 2 ♀♀ 5 o?

3 *Baghdad*, 1 *Sheikh Saad*, 1 *Basra*, 4 *Mesopotamia*, 1 no locality.

Measurements on p. 350.

1577 **Phylloscopus neglectus** Hume (Punjab and Doab) Plain Leaf Warbler 2:458

6: 3 ♂♂ 3 ♀♀

1 *Sari Sarag, 40 m. nw. of Sib, Persian Baluchistan*, 2 Baluchistan, 1 Rawani, 1 Sujabad, Multan, Punjab; 1 Phulji, Larkana, Sind.

No wing bar, pale earthy above & pale eyestripe. The tail is noticeably shorter than in the others. The ♀ 5978 from Sari-Sarag has one primary covert on the right wing white.

Measurements on p. 350.

1578 **Phylloscopus tytleri** Brooks (Kashmir & Simla) Tytler's Leaf Warbler 2:455

10: 5 ♂♂ 5 ♀♀

1 Lidar Valley, Kashmir; 1 Koti State, 1 Tara Div., Patiala, 5 Simla; 1 Malegaon, Surat Dangs; 1 Matheran, Bombay.

The absence of a wingbar, the narrow bill, the olive green above and the long pale yellow eye stripe are distinctive.

Measurements on p. 351.

1579 **Phylloscopus affinis affinis** (Tickell) (Borabhum and Dolbhum) Tickell's Leaf Warbler 2:454

41: 18 ♂♂ 13 ♀♀ 10 o?

1 Multan Valley, 1 Koti State, 2 Fagu, Keonthal, 5 Simla; 1 Niti Pass, 1 Malari, 1 Kedarnath, 1 Badrinath, 1 Mana Pass, Garhwal; 1 Raipur (Berar); 1 Jabalpur; 1 Bababudan Hills, Kadur, Mysore; 1 Naduvattam, 1 Ootacamund, Nilgiris; 1 Keonjhargarh, 1 Ranipathar, Phulbani dist., Orissa; 1 Siliguri, N. Bengal; 1 *Nyenyam, S. Tibet*; 3 Gedu, 1 Honka, 1 nr. Phuntsholing, West, 6 Bumthang, 1 Mangdechu, 1 Shamgong, 1* Tama, Central, 1 Rongtong, East, 1 Gyesta, Bhutan; 1 Dibrugarh, 1 Sadiya, Assam.

None has a dark lower mandible. *♀ No. 26543 is the only one with no eye-stripe.

Measurements on p. 351.

1580 **Phylloscopus affinis arcanus** Ripley (Tikapur, Kailali dist., Western Nepal) Buff-bellied Leaf Warbler.

nil.

1581 **Phylloscopus griseolus** Blyth (banks of Hoogly River, near Calcutta) Olivaceous Leaf Warbler 2:459

23: 9 ♂♂ 7 ♀♀ 7 o?

1 Malakand, N.W.F.P.; 1 Ziarat, Baluchistan; 1 Chashme Shahi, Kashmir Valley, 1 Ajas, 25 m. from Srinagar, Kashmir; 1 Koti State, 3 Ambala, Punjab; 1 Bahawalnagar, Bahawalpur; 1 Delhi; 1 Nadiad, 1

Dabka, Baroda, Gujerat; 2 Bharatpur, 1 Agra; 1 Narwar Fort, Gwalior, C.I.; 1 Jabalpur, 1 Dakna, 2 Kolkaz, Melghat, Amraoti, Berar, C.P., 1 Goregaon, Bombay; 1 Khandala; 1 Molem, Goa.

The key in INDIAN HANDBOOK (2: 133) refers to the supercilium being orange before the eye and yellow behind. The first colour is not visible in any specimen here.

Measurements on p. 351.

1582 **Phylloscopus fuliginventer fuliginventer** (Hodgson) (Nepal) Smoky Leaf Warbler 2:460

2 ♂♂ Mornai, Golpara, Assam.

Measurements on p. 351.

1583 **Phylloscopus fuliginventer tibetanus** Ticehurst (Bombi La, Tsari, S. Tibet) Tibetan Smoky Leaf Warbler

nil.

1584/6 **Phylloscopus fuscatus** subspp.

Specimens borrowed from the British Museum marked *fuscatus* and *weigoldi* can be separated by the depth of colour of the upperparts, but the relative sizes of the wing quills do not correspond to Vaurie's Palearctic Birds No. 9, p. 13. The birds in our collection obtained before 1965 are all too faded to indicate paler/darker birds and only recent specimens have been separated.

1584 **Phylloscopus fuscatus weigoldi** Stresemann (Dschiesong, near Tatsienlu, SE Chwanben) Szechuan Dusky Leaf Warbler

7: 1 ♂ 2 ♀♀ 4 o?

1 Bumthang, 1 Lodrai, Central Bhutan; 2 Narcondam I.; 1 *Bakultala, Middle, 1 o* No. 26433 Chirria Tapoo, 1 Corbyn's Cove, Port Blair, South Andamans.

The difficulties in identification are referred to above. *No. 22099 from Bakultala, Andaman was named *mariae* by Ripley, but the 2nd primary is between 9th & 10th and not equal to 8 as required in the original description. *Mariae* is also discarded by Vaurie and Williamson and the specimen is included here, though it forms the basis for the occurrence of *mariae* in the Andamans. ♂ 24347 from Narcondam has an exceptionally long wing — 68 mm. contra 62 in 2 ♂♂ from E. Bhutan & South Tibet from the B. M.

* No. 26433 d/3 Feb. 1980 from Chirria Tapoo shows yellow on the underparts.

Measurements on p. 351/52.

1585 **Phylloscopus fuscatus mariae** Ripley (Moirang, Manipur) Manipur Dusky Leaf Warbler.

See remarks under last form 1584.

1586 **Phylloscopus fuscatus fuscatus** (Blyth) (Neighbourhood of Calcutta) Siberian Dusky Leaf Warbler 2:461

15: 11 ♂♂ 4 ♀♀

2 Samchi, West Bhutan; 1 Dibrugarh, 1 Margherita, 1 Shillong, 1 N. Cachar, Assam; 1 *Maymyo*, 1 *Prome*, 2 *Ingabu*, 1 *Henzada*; *Burma*; 4 *Peking, China*.

In specimens in good plumage and condition, the relative intensity of the colour of the upperparts is distinctive but the skins from Assam, Burma and China are old and faded and must be assumed as of this race, for the other races have not been recorded there.

Measurements on p. 351/52.

1587 **Phylloscopus pulcher kangrae** Ticehurst (Simla) Western Orange-barred Leaf Warbler 2:465

10: 3 ♂♂ (1...) 5 ♀♀ (1...) 2 o?

1 Dalhousie, Punjab; 2 Kafri, Koti State, 1 Fagu, Keonthal, 5 Simla; 1 Bhim Tal, Kumaon.

Two *P. proregulus* (No. 1594) were registered here.

The tails measure slightly smaller than indicated in INDIAN HANDBOOK. See measurements on p. 352.

1588/1589 **Phylloscopus pulcher pulcher** Blyth (Nepal Valley) Eastern Orange-barred Leaf Warbler 2:464

11: 5 ♂♂ 2 ♀♀ 4 o?

3 Gedu, 1 nr. Phuntsholing, West, 1 Shamgong, 1 Batase, Central, 4 Wamrong, 1 Rongtong, E. Bhutan.

The 5 from eastern Bhutan collected in 1966 are darker and less yellow on the upperparts than others from further west (1967-68).

Measurements on p. 352.

1590 **Phylloscopus inornatus humei** (Brooks) (North-west India) Hume's Yellowbrowed Leaf Warbler 2:469

42: 20 ♂♂ 11 ♀♀ 11 o?

1 *Kaying Bashi, Chinese Turkestan*; 1 Chitral; 1 Murree, Rawalpindi; 1 Yusmarg, 1 Lidar Valley, 1 Chinchora, Bhadrawar, Kashmir; 1 Mashobra, 1 Koti State, 1 Kalka, 12 Simla; 1 Garhwal; 5 Ambala; 1 Ghana Sanctuary, 1 Baretha, Bharatpur; 1 Dabka Baroda, 1 Surat Dangs, Gujarat; 2 Chikalda, Berar; 1 Suriamal, Khodala, Thane, 1 Sankrametta, 1 Anantgiri, Vizagapatnam dist.; 1 Antagarh, Bastar dist., C.P.; 1 Badrama, Bamra, 1 Keonjharghar, Orissa; 1 Baghowni Tirhut; 1 Nepal Valley, 1 Samchi, W. Bhutan.

Several specimens collected by Sálim Ali in Orissa (1948-50) have been marked *P. i. humei* and initialled SAA/RM (Meinertzhagen) but the faint single wing bar, the absence of the pale tips to tertials, the heavier bills, the more prominent rictal bristles and the fact that they have already been marked *"viridanus"* by Amadon (?) appears to indicate that they were wrongly identified and are now being listed under No. 1602 *P. trochiloides viridanus.* The key in INDIAN HANDBOOK 8 p. 153 separates this race on the basis of the "Head Pattern being well marked" but this character is not visible, and is apparently in error. As also the reference to a faint coronal band and short tail. The HANDBOOK also attributes to Horace Alexander the statement that this is the only *Phylloscopus* with a dark tip to the lower mandible, a statement which occurs in Ticehurst too.

Measurements on p. 352/53.

1591 **Phylloscopus inornatus mandellii** (Brooks) (Sikkim) Mandelli's Yellowbrowed Leaf Warbler 2:470

4: 2 ♂♂ 2 o?

1 Upper Barakhamba, Simlipal Hills, Orissa; 1 Gedu, 1 nr. Phuntsholing, West Bhutan, 1 Shamgong, Central Bhutan.

2nd primary between 9th and 10th. Also darkest above.

Measurements on p. 352/53.

1592 **Phylloscopus inornatus inornatus** (Blyth) (Darjeeling) Siberian Yellowbrowed Leaf Warbler 2:470

23: 11 ♂♂ 9 ♀♀ 3 o?

1 Bailadila, 1 Darba, Bastar, C.P.; 1 Koira, 1 Toda, Bonai, Orissa; 1 Rampur, Bihar; 1 Rinchingpong, West Sikkim; 2 Dibrugarh, 1 Shillong, 1 Bishenpur, Manipur; 1 Narcondam I.; 1 *U. Krang, Upper Burma*, 1 *Shudaeng, Prome, Burma*; 9 *Temple of Heaven, Peking, China*; 1 no data.

Sp. No. 20829, ♂ wing 62 mm. from Kaira (Bonai), Orissa dated 17.xii.49 marked *humei* by SA/RM and then *"P. i. inornatus"* by Ripley, who describes the 62 mm. wing as huge.

Measurements on p. 352/53.

1593 **Phylloscopus subviridis** (Brooks) (Etawah, U.P.) Brooks's Leaf Warbler

15: 9 ♂♂ 3 ♀♀ 3 o?

1 Kohat, N.W.F.P., 2 Ladwa, Karnal, 2 Ambala, Punjab; 1 Keonthal, 4 Simla; 2 Cawnpur, 1 Etawah, U.P.; 1 Bharatpur, Rajasthan; 1 Surwaya, Gwalior.

Measurements on p. 353.

1594/6 *Phylloscopus proregulus*

According to the key in INDIAN HANDBOOK (8 p. 158) the underparts of *simlaensis* are dull white tinged with yellow while they should be yellow in both *chloronotus* and *newtoni*. This difference is not visible in the specimens available nor in those borrowed from the B.M. (4 each of nominate *proregulus*, *chloronotus* and *simlaensis*), except perhaps in *simlaensis* and in some of ours too. With those reservations it is very difficult to separate the subspecies and this has been done on the notings by earlier workers.

1594 **Phylloscopus proregulus simlaensis** Ticehurst (Simla) Western Pallas's Leaf Warbler 2:467

19: 10 ♂♂ 3 ♀♀ 6 o?

2 Sonamarg, 1 Yusmarg, 1 Mow, Padar, Kishtwar, Kashmir; 1 Dalhousie, Gurdaspur, 1 Kakuri, 7 Simla, 1 nr. Simla, 4 Koti State, Punjab; 1 Yoshinath, Garhwal.

All these are yellowish-olive above, with a slight wash of yellow on the underparts in some.

Measurements on p. 353/54.

1595 **Phylloscopus proregulus chloronotus** (Gray) (Nepal) Nepal Pallas's Leaf Warbler 2:466

See remarks under 1596.

1596 **Phylloscopus proregulus newtoni** Gaetke (Darjeeling) Pallas's Himalayan Leaf Warbler 2:466

14: 6 ♂♂ 3 ♀♀ 5 o?

1 Rinchingpong, Sikkim; 2 Chima Kothi, 1 Chapcha, West, 2 Shamgong, 2 Tanna, 1 Bumtang, Central, 1 Narphong, 1 Wamrong, 1 Gomchu, 1 Rongtong, East Bhutan; 1 Singtam, Teesta Valley, Rangpur, Bengal.

These 14 from Sikkim and Bhutan have much less yellow below than birds from Simla (*simlaensis*). Therefore the key in INDIAN HANDBOOK 8 p. 158 separating this as dull white tinged with yellow *contra chloronotus* with underparts yellow, is hardly workable. However they are darker above, making then *newtoni*.

4 specimens from the B.M. [1934, 1936 & 1938(2) from southeast and south Tibet] all obtained in May are marked *chloronotus*. Ticehurst (1938) & Williamson (1962) have included *newtoni* therewith. Ripley in Birds of Nepal 1947-1949 (JBNHS 49 p. 401, misprinted 101 in INDIAN HANDBOOK 8: 159) has accepted both races in INDIAN HANDBOOK those from eastern Nepal and eastward being *newtoni* and all the birds available are so marked and listed accordingly.

Measurements on p. 353/54.

EL. **Phylloscopus proregulus proregulus** (Pallas) (Ingoda River, S.E. Transbaikalia).

2: 1 ♂ 1 ♀ *Temple of Heaven, Peking, China.*

These go back to 1900 and are in very poor condition. The yellow on the underparts is replaced by white.

Measurements on p. 353/54.

1597 **Phylloscopus maculipennis virens** Ticehurst (Saraj, Punjab Himalayas) Western Greyfaced Leaf Warbler 2:463

3: 1 ♂ 2 ♀♀

1 Koti State (8000′); 1 Tara Devi, 1 Patiala State (6000′).

The white in the tail separates the species, as also *pulcher*, from the only others (*proregulus*) with a yellow rump. These specimens are almost topotypes and differ from the others in being paler both above and below.

Measurements on p. 354.

1598 **Phylloscopus maculipennis centralis** Ripley (Rekcha, Dailekh dist., Western Nepal)

nil.

1599 **Phylloscopus maculipennis maculipennis** (Blyth) (Nepal, restricted to Ilam dist., eastern Nepal) Eastern Greyfaced Leaf Warbler 2:463

9: 7 ♂♂ 1 ♀ 1 o?

2 Chungthang, 2 Rinchingpong, N. Sikkim; 1 Gedu, 1 Chapcha, 1 Chima Kothi, 1 near Phuntsholing, West, 1 Wamrong, East Bhutan.

This is noticeably smaller than *pulcher* and has a very distinct dark cap on the head.

Measurements on p. 354.

1600 **Phylloscopus borealis borealis** (Blasius) (Sea of Okhotsk) Arctic Leaf Warbler 2:472

2 ♂♂ *Temple of Heaven, Peking, China.*

As in *trochilus* this is distinguished by the absence of the emargination on the 6th primary.

Measurements on p. 354.

1601 **Phylloscopus magnirostris** Blyth (Calcutta) Largebilled Leaf Warbler 2:476

6: 5 ♂♂ 1 o?

1 Changa Gali, Murree; 2 Koti State, 1 Simla; 1 Mussoorie, U.P.; 1 Santhanpara, Cardamom Hills, Travancore.

Can be distinguished from *Phylloscopus borealis* by the larger bill, longer tail and the emargination on the 6th primary.

Measurements on p. 354.

1602 **Phylloscopus trochiloides viridanus** Blyth (Calcutta) Western Greenish Leaf Warbler 2:474

75: 35 ♂♂ 24 ♀♀ 16 o?

1 *Tashkant, U.S.S.R.*; 8 Simla, 1 Patiala; 1 Bharatpur; 1 Nadiad, Kaira, 1 *Dediapada, Rajpipla, 1 Cambay City environs, 1 Mheskatri, Surat Dangs; 1 Raipur, Melghat Berar, 2 Andheri, Bombay, 1 Raita, Kalyan; 1 Khandala, 1 Satara; 1 Balemani, 1 Coompta, N. Kanara; 1 Mercara, Coorg, 1 Wynaad; 1 Kotagiri, Nilgiris, 1 Kumili, Periyar Lake; 1 Muthukuzi, Ashambu Hills, Travancore; 2 Shambaganur, 1 Kodaikanal, Madurai; 2 Pt. Calimere, Tanjore; 1 Kurumbapatti, Salem, 1 Nellamalai Range, S. Kurnool; 1 Jeypore Agency, Vizagapatnam; 1 Jabalpur, 4 Bhanupratappur, Kankar, 1 Darba, 1 Balladila, Bastar; C.P.; 2 Sankrametta, 1 Barkul, Chilka Lake, 1 Berbera, Puri Dist., 1 Mahendragiri; 1 Tikarpara, Angal dist., Orissa; 3 Badrama (Bamra), 6 Keonjhargarh, 1 Toda, 5 Koira, Bonai, 1 Kuldiba, 2 Nilgiri, 1 Daspur, 3 Chakala, Simlipal Hills, Mayurbhanj, Orissa; 1 Cawnpur, 1 Pothribassa, Garhwal, U.P.; 1 Darjeeling; 1 Madhubani (missing).

*Sp. No. 6112 from Dediapada, Rajpipla, was the specimen recorded as *P. trochilus acredula* the "only record of this species from India". See note *JBNHS.* 83: 209.

Measurements on p. 355.

1603 **Phylloscopus trochiloides ludlowi** Whistler (Maran River, near Kishtwar) Baltistan Greenish Leaf Warbler 2:474 (part)

8: 2 ♂♂ 2 ♀♀ 4 o?

3 Nila Valley, Garhwal; 1 Anantgiri, 1 Shankrametta, 1 R. V. Nagar, Vizagapatnam, 2 Coonoor, Nilgiris.

The 3 from Nila Valley, Garhwal, were originally preserved in spirit and have then been taken out and dried. They were named *lugubris* i.e. *ludlowi* by C.B.T. The one from Anantgiri in the Eastern Ghats was obtained as late as 4 May (1930).

Measurements on p. 355.

1604 **Phylloscopus trochiloides trochiloides** (Sundevall) (Calcutta) Eastern Greenish Leaf Warbler 2:474 (part)

8: 5 ♂♂ 1 ♀ 2 o?

1 Kalijhora, Tista Valley, Sikkim; 1 Sukna, Darjeeling dist.; 1 Rewa Tea Estate, Gorakhpur, Sylhet, Assam; 1 Chakala, Simlipal Hills, Mayurbhanj, Orissa; 1 Wynaad, S. India; 1 Bambooflats, 1 Wrightmyo, 1 Chauldhari, S. Andamans.

Measurements on p. 355.

1605 **Phylloscopus trochiloides nitidus** Blyth (Vicinity of Calcutta) Bright Green Leaf Warbler 2:473

26: 12 ♂♂ 10 ♀♀ 4 o?

6 Simla, 1 Patiala State, 3 Koti State, 1 Barsatpur, Bhajji State; 1 Delhi; 1 Ghana Sanctuary, Bharatpur; 1 Agra, U.P.; 1 Khavda, Padam Is., Kutch; 1 Waghai, Surat Dangs, Gujerat; 1 Suriamal, Khodala, Thane; 1 Kihim, Kolaba dist.; 1 Rajapur, Ratnagiri; 1 Canacona, Goa; 1 N. Kanara; 1 Maraiyur, 1 Rajanpara, Pandalam Hills, Kerala; 1 Point Calimere, Thanjavur dist., T.N.; 1 Kodhaludu, Sriharikota, Nellore, 1 Seshachalam Hills, S. Cuddapah, A.P.

The bill is visibly narrower than in *viridanus* though said to be "coarser" in Ticehurst p. 152. There is a very slight emargination on the 6th primary and the underparts usually show a yellow wash.

Measurements on p. 355.

EL. **Phylloscopus trochiloides plumbeitarsus** Swinhoe (Taku & Peking) Middendorf's Willow Warbler 2:474

1 o? *Htugyi, Henzada, Burma.*

1605a **Phylloscopus tenellipes** Swinhoe (Amoy, SE China) Palelegged Leaf Warbler 2:477

3 ♂♂ All Narcondam Island, 22, 23 and 29 March 1972.

Measurements on p. 355.

1606 **Phylloscopus occipitalis occipitalis** (Blyth) (Southern India*) Large Crowned Willow Warbler 2:479

*The type specimen was obtained at Nellore, Madras, by Jerdon, (Birds of India 2:196)

40: 20 ♂♂ 10 ♀♀ 10 o?

1 Gulmarg, 1 Lidar Valley, 1 Sonamarg, 1 Chichoti, 2 Palaili Podar, Kishtwar, 1 Kashmir; 5 Simla, 2 Koti State, 2 Keonthal, 1 Tara Devi, 1 Patiala; 1 Lambathatch, 4 Garhwal; 1 Choral, Indore; 1 Bodeli, Baroda, 1 Galkund, 1 Mheskatri, Surat Dangs; 2 Molem, 2 Canacona, Goa; 1 Karwar, 1 N. Kanara; 1 Devamalai, Pandalam Hills, 2 Merchiston, Ponmudi, S. Travancore; 1 Kurumbapatti, Salem; 1 Anantgiri, Vizagapatnam; 1 Geedam, 1 Darba, Bastar, M.P.

None of them agrees with the description of 1607 *P. o. coronatus* below.

Measurements on p. 356.

1607 **Phylloscopus occipitalis coronatus** (Temminck & Schlegel) (Japan) Eastern Crowned Leaf Warbler 2:480

nil.

In INDIAN HANDBOOK 8 p. 172, it is said that all records north of c. 21°N. are from October to April. "North" is of course a slip for "south".

1608 **Phylloscopus reguloides kashmiriensis** Ticehurst (Simla) Blyth's Leaf Warbler.

14: 7 ♂♂ 3 ♀♀ 4 o?

1 Dalhousie, 1 Dakuri, Punjab; 1 Huttu, Bushahr State, 3 Simla; 1 Garbyang, Almora Dist., 1 Pilibhit Terai, U.P., 1 Pt. Calimere, T.N.; 1 Kuldiha, Nilgiri, 1 Badrama, Bamra, 2 Toda Bonai, 1 Gurguria, Mayurbhanj, Orissa.

The races as generally admitted are difficult to separate, but the western birds are less yellow on the underparts and are paler above. ♂ No. 23693 d/24 Nov. 1970 from Pt. Calimere is almost white below while all from Orissa were obtained by Salim Ali in December 1949.

Measurements on p. 356.

1609 **Phylloscopus reguloides reguloides** (Blyth) (Darjeeling) Blyth's Crowned Leaf Warbler

13: 9 ♂♂ 2 ♀♀ 2 o?

1 Rampur, Bihar; 2 Singtam, Teesta Valley, 1 Berrik, Sikkim; 3 Gedu, 1 Honka, 1 Samchi, West, 1 Mangdechu, Central Bhutan; 2 Dibrugarh, 1 Cachar Hills, Assam.

As indicated these show more yellow on the underparts, and on the wing bars, and are also darker above.

Measurements on p. 356.

1610 **Phylloscopus reguloides assamensis** Hartert (Peak near Shillong, Khasia Hills) Assam Crowned Leaf Warbler 2:481

2: 1 ♂ 1 ♀

1 Gedu, Western, 1 Bumtang, Eastern Bhutan.

This race is reluctantly accepted by Ticehurst and Vaurie but these two have wider white inner margins to the outer tail feathers as required in the key in INDIAN HANDBOOK (8 p. 175). Two from Dibrugarh, nearer the type locality, do not show this character and are left with nominate *reguloides.*

Measurements on p. 356.

1611 **Phylloscopus reguloides claudiae** (La Touche) (Mengtz, Yunnan) Crown Leaf Warbler 2:483

nil.

1612 **Phylloscopus cantator cantator** (Tickell) (Borabhum & Dolbhum) Blackbrowed or Yellowfreed Leaf Warbler 2:492

5: 2 ♂♂ 2 ♀♀ 1 o?

1 Kalijhora, Tista Valley, Sikkim; 1 Tama, 3 Mangdechu, Central Bhutan.

Measurements on p. 356.

EL. **Phylloscopus davisoni** (Oates) (Muleyit Mt., N. Tenasserim) Tenasserim White-tailed Willow Warbler 2:482

1 o? *Simla, Upper Burma.* Wing 55; Bill 9.5; Tarsus 16.7; Tail 42.

1613 **Seicercus affinis** (Hodgson) (Nepal) Allied Flycatcher-Warbler 2:486

6: 3 ♂♂ 1 ♀ 2 o?

1 Tama, 2 Shamgong, Central Bhutan; 1 Miao, Arunachal Pradesh; 2 Margherita, Assam.

Measurements on p. 356.

1614 **Seicercus burkii whistleri** Ticehurst (Dharmsala, Punjba, Himalayas) Western Blackbrowed Flycatcher-Warbler 2:487

13: 6 ♂♂ 4 ♀♀ 3 o? are placed in two groups:

(a) 9: 4 ♂♂ 3 ♀♀ 2 o?

1 Ganna-ki-hatti, Dharma State, 2 Koti State, 1 Kalka, 1 Patiala, 1 Simla; 1 Bailadila, Bastar M.P.; 1 Upper Sileru, 1 Lamasinghi, Vizagapatnam.

(b) 4: 2 ♂♂ 1 ♀ 1 o?

3 Gedu, 1 Honka, Western Bhutan.

Paler above and nearer to *whistleri* than others from central and eastern Bhutan.

Records of the species from the plains of India (McMaster at Kampti and Chikalda in Berar, Blyth at Calcutta) were doubtfully treated (Old Fauna 1 p. 424) and omitted in Stuart Baker. Their obtention in the Eastern Ghats and in Bastar, M.P. in more recent years has revived the older records.

The four from Western Bhutan cannot be separated from *whistleri* from the Simla Hills. Those from Sikkim and central and eastern Bhutan are a shade darker and Sikkim does not appear to be a very suitable type locality for nominate *burkii.* They are included here and the measurements separately recorded as *whistleri* (b).

Measurements on p. 357.

1615 **Seicercus burkii burkii** (Burton) (Himalayan Mts., restricted to Sikkim by Ticehurst) Eastern Blackbrowed Flycatcher-Warbler 2:487

19: 13 ♂♂ (1 juv.) 1 ♀ 5 o?

2 Martam, Rogni Valley, 1 Singtam, Teesta Valley, 1 Pershoke, Sikkim; 1 Shamgong, C. Bhutan; 2 Rangpo, 2 Deothang, 1 Rongtong, E. Bhutan, 1 Longview, 1 Jore Pokhari, Darjeeling; 2 Doyang, 2 Dibrugarh, 1 Margherita, 1 Hailakhandi Cachar, Assam; 1 Kohima, Naga Hills.

The juvenile male (Jore Pokhari, 7500′, Darjeeling 19-8-05) has no distinct pattern on the head. In INDIAN HANDBOOK, 8 p. 183, and in SYNOPSIS the original description by Burton is erroneously said to be in 1836 instead of 1835. A wing bar is present.

Measurements on p. 357.

1615a **Seicercus burkii tephrocephalus** (Anderson) (Bhamo) Burmese Blackbrowed Flycatcher-Warbler 2:488

nil.

1616 **Seicercus xanthoschistos albosuperciliaris** (Jerdon) (Cashmere) Western Greyheaded Flycatcher-Warbler 2:490

26: 11 ♂♂ 8 ♀♀ 7 o?

1 Attock, West Punjab; 1 Moghul Maidan, Kishtwar, Kashmir; 1 Koti State, 1 Keonthal, 12 Simla; 1 Karuprayag, 1 Guptakashi, Garhwal; 1 Ambala, Punjab; 2 Almora, 1 Muktisar, Kumaon; 4 Mussoorie, U.P.

Paler above and less yellow below than nominate *xanthoschistos.* No wing bar.

Measurements on p. 357.

1617 **Seicercus xanthoschistos xanthoschistos** (Gray) (Nepal) Nepal Greyheaded Flycatcher-Warbler 2:489

18: 12 ♂♂ 3 ♀♀ 3 o?

1 Chungthang, north, 1 Kewzing, Sikkim; 1 Gedu, 1 Sanchi, west 2 Shamgong, central, 1 Tashigong, 3 Wamrong, 1 Gomchu, 2 Rongtong, East Bhutan; 1 Sadiya, Upper Assam, 3 Dibrugarh, 1 Kangpokpi, Manipur.

Curiously there are twelve males to only three females.

Measurements on p. 357.

1618 **Seicercus xanthoschistos flavogularis** (Godwin-Austen) (neighbourhood of Saddya, Assam) Mishmi Greyheaded Warbler 2:484

The footnote to p. 443 of Ripley's SYNOPSIS, 2nd edition (1982) indicates that the first description is based on an aberrant specimen and that it is not separable from nominate *xanthoschistos.*

1619 **Seicercus xanthoschistos tephrodiras** Sick (Mt. Victoria, Chin Hills) Assam Greyheaded Flycatcher-Warbler

3: 1 ♂ 2 o?

1 Shillong, 2 Laithensew,, Khasia Hills.

INDIAN HANDBOOK & SYNOPSIS both refer to birds from Manipur as of this form, but the single specimen from Kangpokpi, Manipur marked *teprodiras* by Ripley appears closer to nominate *xanthoschistos* in colour and has the longer tail of that race.

Measurements on p. 357.

1620 **Seicercus poliogenys** (Blyth) (Darjeeling) Greyheaded Flycatcher-Warbler 2:49

8: 4 ♂♂ 1 ♀ 3 o?

1 Honka, West, 1 Batase, Central, 1 Deothong, 1 Narphong, East Bhutan; 1 Margherita, Assam; 1 Miao, 1 140 m. from Miao, Tirap Div., Arunachal Pradesh; 1 Bishenpur, Manipur.

The key to species in Fauna 2 p. 486 shows a grey chin as separating this from *xanthoschistos* but this character is only clearly visible in the two from Arunachal Pradesh.

The species has one wing bar and a dark grey cap.

Measurements on p. 357.

1621 **Seicercus castaniceps castaniceps** (Hodgson) Chestnut-headed Flycatcher-Warbler 2:492

10: 2 ♂♂ 4 ♀♀ 4 o?

3 Rangpo, 1 Singtam, Teesta Valley, 1 Martam, Rongni Valley, 1 Singhik, Sikkim; 1 Shamgong, C. Bhutan; 1 5500′ Woodcot, 1 7500′ Darjeeling, Bengal; 1 Bhuchang, Upper Assam.

No. 6158 ♂ Darjeeling 18/8/05 with no rufous on head, the small (7 mm.) bill and tail (30 mm.) indicate a juvenile specimen in which the upperparts are more rufous than grey or olive green and the tertiaries are tipped with white. Unsexed No. 21791 also from Darjeeling has a dull rufous head indicating an immature plumage.

Measurements on p. 358.

1622 **Abroscopus superciliaris flaviventris** (Jerdon) (Darjeeling, Northern West Bengal) Sikkim Yellow-bellied Flycatcher-Warbler 2:494/5

5: 4 ♂♂ 1 o?
1 Kalijhora 550′, Teesta Valley, 2 Berrik 450′, 1 Martam 2000′, Rongni Valley, Sikkim; 1 Deothang, E. Bhutan.

The head is the same colour as the back, while the underparts are slightly paler than in the next form. The white over the eye is also more distinct. The wing measurements "50-60 mm." in INDIAN HANDBOOK (8 p. 191) are much larger than in the FAUNA, 46-52, and in our present series (47-53) and may be in error.

Measurements on p. 358.

1623 **Abroscopus superciliaris drasticus** Deignan (Margherita, Lakhimpur dist., Assam) Arunachal Yellowbellied Flycatcher-Warbler 2:494

5: 1 ♂ 1 ♀ 3 o?
2 Firm Base, 2 Miao, Tirap Div., 1 Namorah, Kameng Dist., Arunachal Pradesh.

The head is varyingly distinct (greyer) from the rest of the upperparts and the underparts a slightly brighter yellow than 1622 (*A. s. flaviventris*).

Measurements on p. 358.

1624 **Abroscopus schisticeps schisticeps** (Gray) (Nepal) Nepal Blackfaced Flycatcher-Warbler 2:495

nil.

1625 **Abroscopus schisticeps flavimentalis** (Baker) (Mt. Victoria) Assam Blackfaced Flycatcher-Warbler.

3 ♂♂
1 Gedu, West, 2 Samchi, E. Bhutan.

With no topotypes of either race it is difficult to determine the subspecies by the extent of yellow on the chin and breast. According to the distribution in Stuart Baker's FAUNA (2 p. 497) birds north of the Brahmaputra should be of the nominate race and this is also supported by the wing measurements being closer 49, 50, 50 against smaller 46-48 in *flavimentalis* 1924 (*Bull BOC 44* p. 63). I am however leaving the Bhutan birds here as in INDIAN HANDBOOK.

Measurements on p. 358.

1626 **Abroscopus albogularis albogularis** (Horsfield & Moore) (Nepal) Whitethroated Flycatcher-Warbler 2:498

4: 2 ♂♂ 2 ♀♀
1 Shamgong, C. Bhutan, 2 Margherita, Assam; 1 Miao, Tirap Div., Arunachal Pradesh.

At first glance, the impression is of a blackthroated and not whitethroated bird.

Measurements on p. 358.

1627 **Abroscopus hodgsoni hodgsoni** (Moore) (Nepal) Broadbilled Flycatcher-Warbler 2:500

2 ♀♀
1 Gedu, 1 nr. Phuntsholing, West Bhutan.

Measurements on p. 358.

1628 **Regulus regulus tristis** Pleske (Merv) Turkestan Goldcrest 2:541

nil.

1629 **Regulus regulus himalayensis** Bonaparte ('les montes Himalaya' restricted to Kotgarh, Simla Hill States) Himalayan Goldcrest 2:539

14: 8 ♂♂ 3 ♀♀ 3 o?
1 Murree, Rawalpindi; 1 Lidar Valley, Kashmir; 1 Koti, 1 Kufri, 2 Fagu, 1 Keonthal State, 6 Simla; 1 Dentam, W. Sikkim.

There is much variation in the extent of "gold" on the forehead and they can all be included in the series from Simla. Some of the specimens marked "ad ♂" have the median band on the head as pale yellow as in the females, and in one male marked juvenile. Unsexed specimen No. 21706 from Sikkim is marked *himalayensis* by Ripley and is for the moment included here.

Measurements on p. 359.

1630 **Regulus regulus sikkimensis** R & A Meinertzhagen (Sikkim) Sikkim Goldcrest 2:539

nil.

1631 **Regulus regulus yunnanensis** Rippon (Yangtze River, W. Yunnan) Yunnan Goldcrest 2:541

nil.

EL. **Regulus regulus japonensis** Blakiston (Hokkaido, Japan)

2: 1 ♂ 1 ♀

2 *Temple of Heaven, Peking, China.*

The measurements when compared with those of *himalayensis* are slightly larger, and the outer cheeks greyer and according to de Schauensee BIRDS OF CHINA (1984) this should be within the distributional range of *japonensis.* Both skins are in very poor condition.

Measurements on p. 359.

1632 **Leptopoecile elegans** Przevalski (Upper Yellow River, Southeast Tsinghai) Crested Tit-Warbler

nil.

1633 **Leptopoecile sophiae sophiae** Severtzov (pinewoods at Issyk-Kul Kirghez) Turkestan Tit-Warbler 2:542

nil.

1634 **Leptopoecile sophiae obscura** Przevalski (Mountain forests of north eastern Tibet) Tibetan Tit-Warbler 2:543

3: 1 ♂ 1 ♀ 1 o? All *Gyantse, Tibet.*

The blue is greatly faded but in life this must be a most beautiful bird.

Measurements on p. 359.

1572 & EL **Phylloscopus trochilus** subspp.

	Wing	*Bill*	*Tarsus*	*Tail*
(1572) *acredula* ♂ (1)	69	10	19.5	49
	(IH 64-72	from skull 11-12	20-21	49-56) (Williamson)
EL *trochilus* ♀ (1)	64	9	18.5	46
	(Williamson 60-66	from skull 10-15	19-22	42-50)

1574/76 & EL **Phylloscopus collybita** subspp.

	Wing	*Bill*	*Tarsus*	*Tail*
♂ ♂				
1574 *collybita* (4)	58, 59, 60, 60	7.8, 9, 9.5, 9.7	16.8, 17.8, 18, 19.3	43, 43, 44, 46
	(Ticehurst 59-63	from skull 11.5-12.5	17.5-19.5	47-52)
1575 *tristis* (18)	55-63 av. 58.9	7.5-9.7 av. 8.6	16.5-20.7 av. 18.7	44-52 av. 47.8
	(Ticehurst 60-66.5	from skull 11.5-12.5	17.5-19.5	49-55)
1576 *sindianus* (2)	54, 58	8, 9.4	17.7, 19.5	43, 49
	(Ticehurst 51-63	from skull 11-12	18.5-19.5	48-54)
EL *abietinus* (3)	61, 63, 65	9, 9.2, 10.5	18.7, 20, 21	44, 48, 50
	(Ticehurst 61-66.5	from skull 11.5-12.5	17.5-19.5	49-54)
♀ ♀				
collybita (4)	54, 55, 56, 62	8.7, 9.2, 9.4, 10	15.5, 18.8, 19.2, 19.4	41, 41, 46, 48
	(Ticehurst 55-59	from skull 11.5-12.5	17.5-19.5	41-48.5)
tristis (19)	53-64 av. 57.1	7.7-10.6 av. 8.8	16.4-20.3 av. 18.1	41-50 av. 45
	(Ticehurst 55-59	from skull 11.5-12.5	17.5-19.5	44.5-48)
sindianus (2)	49, 54	7.6, 8.7	16.6, 19.8	42, 42
	(Ticehurst 51.5-57	from skull 11-12	18.5-19.5	43-48)
abietinus (2)	60.5, 61	8.6, 9.7	16.6, 20	45, 48
	(Ticehurst 57-60	from skull 11.5-12.5	17.5-19.5	44-50)
o?				
collybita (5)	54-59 av. 57.2	8.3-10.5 av. 9.5	18.3-20.6 av. 19.6	44-47 av. 45.6
tristis (14)	53-62 av. 57.7	8-10.2 av. 8.7	17.2-21 av. 17.8	42-48 av. 45.5
sindianus (1)	59	9.7	20	45
abietinus (5)	61-65 av. 62.8	9.2-10 av. 9.8	17-19.7 av. 18.5	47-49 av. 48.4

1577 **Phylloscopus neglectus**

	Wing	*Bill*	*Tarsus*	*Tail*
♂ ♂ (3)	50, 51, 52	8.5, 9.9, 10.1	16.5, 17.3, 18.5	37, 37, 39
	(IH 49-55	from skull 9-11	17-19	39-43)
♀ ♀ (3)	48, 48, 51	8.5, 9.9, 10	18, 18.1, 20.3	35, 37, 38
	(IH 47-51	from skull 9-11	17-19	37-42) (CBT, HW)

1578 **Phylloscopus tytleri**

	Wing	*Bill*	*Tarsus*	*Tail*
♂♂ (5)	54-61 av. 58.4	9.1-12.2 av. 10.1	15.8-20 av. 18.3	38-45 av. 41
	(IH 58-63	from skull 13-14	17-18	42-46)
♀♀ (5)	55-56 av. 55.4	9.2-10.7 av. 10.1	16-17.7 av. 16.5	38-40 av. 39.2
	(IH 53-60	from skull 13-14	17-18	39-43)

1579 **Phylloscopus affinis**

	Wing	*Bill*	*Tarsus*	*Tail*
♂♂ (18)	56-62 av. 57.9	8.5-10.5 av. 9.4	16.3-20.3 av. 18.2	40-47 av. 44
	(IH 51-63	from skull 12-13	18-19	44-51)
♀♀ (13)	50-59 av. 55	8.3-10.5 av. 9.3	15.5-19.1 av. 17.9	37-49 av. 41
	(IH 51-61	from skull 12-13	18-19	39-48)
				(CBT, BB, HW)
o? (10)	53-60 av. 56.2	8.4-10.5 av. 9	16.8-19.7 av. 18.1	39-50 av. 42.8

1581 **Phylloscopus griseolus**

	Wing	*Bill*	*Tarsus*	*Tail*
♂♂ (9)	61-67 av. 64.4	10.6-12 av. 10.9	18.6-21.8 av. 19.6	47-53 av. 49.8
	(IH 65-67	from skull 14-15	20-21	49-52)
♀♀ (7)	57-63 av. 59.1	10.5-12 av. 10.8	18.8-20.3 av. 19.4	43-50 av. 44.8
	(IH 63-68	from skull 14-15	20-21	50-53)
				(HW, SA)

1582 **Phylloscopus fuligiventer fuligiventer**

	Wing	*Bill*	*Tarsus*	*Tail*
♂♂ (2)	50, 54	9.8, 10.5	19.4, 20	39, 39
♂♂ B.M. (3)	53, 57, 57	9.8, 10, 10.3	20.4, 21, 21.3	40, 46, 47
♀♀ B.M. (1)	56	10.5	19.9	40
	(IH ♂♀ 51-61	from skull 12-14	19-22	40-50)
				(Williamson)

1584/86 **Phylloscopus fuscatus** subspp.

	Wing	*Bill*	*Tarsus*	*Tail*
♂♂				
1584 *weigoldi* (1)	68	—	21.5	55
„ (B.M.) (2)	62, 62	10.8, 11.8	20.2, 20.9	48, 54
	(IH 56-67	from skull 12-14	21-23	48-56)
				(CBT, Williamson)
1586 *fuscatus* (11)	54-63 av. 59.5	9-10.8 av. 10.1	18.9-21.8 av. 21	43-55 av. 49.6
„ (B.M.) (3)	60, 63, 63	9.6, 10.1, 10.3	20, 21.3, 21.8	50, 53, 54
	(IH 58-70	from skull 12-13	20-22	46-59)
				(Williamson, Hartert)

1572 & EL **Phylloscopus trochilus** subspp.

	Wing	*Bill*	*Tarsus*	*Tail*
(1572) *acredula* ♂ (1)	69	10	19.5	49
	(IH 64-72	from skull 11-12	20-21	49-56)
				(Williamson)
EL *trochilus* ♀ (1)	64	9	18.5	46
	(Williamson 60-66	from skull 10-15	19-22	42-50)

1574/76 & EL **Phylloscopus collybita** subspp.

♂♂				
1574 *collybita* (4)	58, 59, 60, 60	7.8, 9, 9.5, 9.7	16.8, 17.8, 18, 19.3	43, 43, 44, 46
	(Ticehurst 59-63	from skull 11.5-12.5	17.5-19.5	47-52)
1575 *tristis* (18)	55-63 av. 58.9	7.5-9.7 av. 8.6	16.5-20.7 av. 18.7	44-52 av. 47.8
	(Ticehurst 60-66.5	from skull 11.5-12.5	17.5-19.5	49-55)
1576 *sindianus* (2)	54, 58	8, 9.4	17.7, 19.5	43, 49
	(Ticehurst 51-63	from skull 11-12	18.5-19.5	48-54)
EL *abietinus* (3)	61, 63, 65	9, 9.2, 10.5	18.7, 20, 21	44, 48, 50
	(Ticehurst 61-66.5	from skull 11.5-12.5	17.5-19.5	49-54)
♀♀				
collybita (4)	54, 55, 56, 62	8.7, 9.2, 9.4, 10	15.5, 18.8, 19.2, 19.4	41, 41, 46, 48
	(Ticehurst 55-59	from skull 11.5-12.5	17.5-19.5	41-48.5)
tristis (19)	53-64 av. 57.1	7.7-10.6 av. 8.8	16.4-20.3 av. 18.1	41-50 av. 45
	(Ticehurst 55-59	from skull 11.5-12.5	17.5-19.5	44.5-48)
sindianus (2)	49, 54	7.6, 8.7	16.6, 19.8	42, 42
	(Ticehurst 51.5-57	from skull 11-12	18.5-19.5	43-48)
abietinus (2)	60.5, 61	8.6, 9.7	16.6, 20	45, 48
	(Ticehurst 57-60	from skull 11.5-12.5	17.5-19.5	44-50)
o?				
collybita (5)	54-59 av. 57.2	8.3-10.5 av. 9.5	18.3-20.6 av. 19.6	44-47 av. 45.6
tristis (14)	53-62 av. 57.7	8-10.2 av. 8.7	17.2-21 av. 17.8	42-48 av. 45.5
sindianus (1)	59	9.7	20	45
abietinus (5)	61-65 av. 62.8	9.2-10 av. 9.8	17-19.7 av. 18.5	47-49 av. 48.4

1577 **Phylloscopus neglectus**

♂♂ (3)	50, 51, 52	8.5, 9.9, 10.1	16.5, 17.3, 18.5	37, 37, 39
	(IH 49-55	from skull 9-11	17-19	39-43)
♀♀ (3)	48, 48, 51	8.5, 9.9, 10	18, 18.1, 20.3	35, 37, 38
	(IH 47-51	from skull 9-11	17-19	37-42)
				(CBT, HW)

1578 **Phylloscopus tytleri**

	Wing	*Bill*	*Tarsus*	*Tail*
♂♂ (5)	54-61 av. 58.4	9.1-12.2 av. 10.1	15.8-20 av. 18.3	38-45 av. 41
	(IH 58-63	from skull 13-14	17-18	42-46)
♀♀ (5)	55-56 av. 55.4	9.2-10.7 av. 10.1	16-17.7 av. 16.5	38-40 av. 39.2
	(IH 53-60	from skull 13-14	17-18	39-43)

1579 **Phylloscopus affinis**

♂♂ (18)	56-62 av. 57.9	8.5-10.5 av. 9.4	16.3-20.3 av. 18.2	40-47 av. 44
	(IH 51-63	from skull 12-13	18-19	44-51)
♀♀ (13)	50-59 av. 55	8.3-10.5 av. 9.3	15.5-19.1 av. 17.9	37-49 av. 41
	(IH 51-61	from skull 12-13	18-19	39-48)
				(CBT, BB, HW)
o? (10)	53-60 av. 56.2	8.4-10.5 av. 9	16.8-19.7 av. 18.1	39-50 av. 42.8

1581 **Phylloscopus griseolus**

♂♂ (9)	61-67 av. 64.4	10.6-12 av. 10.9	18.6-21.8 av. 19.6	47-53 av. 49.8
	(IH 65-67	from skull 14-15	20-21	49-52)
♀♀ (7)	57-63 av. 59.1	10.5-12 av. 10.8	18.8-20.3 av. 19.4	43-50 av. 44.8
	(IH 63-68	from skull 14-15	20-21	50-53)
				(HW, SA)

1582 **Phylloscopus fuligiventer fuligiventer**

♂♂ (2)	50, 54	9.8, 10.5	19.4, 20	39, 39
♂♂ B.M. (3)	53, 57, 57	9.8, 10, 10.3	20.4, 21, 21.3	40, 46, 47
♀♀ B.M. (1)	56	10.5	19.9	40
	(IH ♂♀ 51-61	from skull 12-14	19-22	40-50)
				(Williamson)

1584/86 **Phylloscopus fuscatus** subspp.

♂♂				
1584 *weigoldi* (1)	68	—	21.5	55
,, (B.M.) (2)	62, 62	10.8, 11.8	20.2, 20.9	48, 54
	(IH 56-67	from skull 12-14	21-23	48-56)
				(CBT, Williamson)
1586 *fuscatus* (11)	54-63 av. 59.5	9-10.8 av. 10.1	18.9-21.8 av. 21	43-55 av. 49.6
,, (B.M.) (3)	60, 63, 63	9.6, 10.1, 10.3	20, 21.3, 21.8	50, 53, 54
	(IH 58-70	from skull 12-13	20-22	46-59)
				(Williamson, Hartert)

1584/86 **Phylloscopus fuscatus** subspp. (contd.)

	Wing	*Bill*	*Tarsus*	*Tail*
♀♀				
1584 *weigoldi* (2)	57, 62	10.2, 11.2	20.6, 21.4	46, 50
	(IH 53-60	from skull 12-14	21-23	42-49)
			(CBT, Williamson)	
1586 *fuscatus* (4)	53-58 av. 55.2	9.3-10.9 av. 10	18.8-20.9 av. 19.7	43-48 av. 45.2
„ (B.M.) (1)	60	9.6	21.3	54
	(IH 53-61	from skull 12-13	20-22	43-51)
			(Williamson, Hartert)	
o?				
1584 *weigoldi* (4)	51-60 av. 56.4	9.5-10.1 av. 9.8	18-22.2 av. 20.4	44-52 av. 47.8
„ (B.M.) (2)	56, 58	10.3, 10.5	20, 21.9	45, 47

1587-89 **Phylloscopus pulcher** subspp.

	Wing	*Bill*	*Tarsus*	*Tail*
♂♂				
1587 *kangrae* (3)	56, 57, 58	9, 9.3, —	16.2, 17, 17.6	39, 39, 40
	(IH measurements as in 1589)			
1588/9 *pulcher* (5)	55-60 av. 58	9.3-10.5 av. 9.9	17-20.3 av. 18.6	37-42 av. 40.4
	(IH 53-62	from skull 12-13	18-21	40-45)
♀♀				
kangrae (5)	52-59 av. 55.8	8.8-9.7 av. 9	16.4-17.3 av. 16.8	36-41 av. 38
pulcher (2)	52, 54	9.1, 10.3	17.8, 18.5	36, 38
	(IH 52-63	from skull 12-13	18-21	37-42)
o?				
kangrae (2)	54, 56	9, 9	15.6, 17	38, 38
pulcher (4)	53, 54, 56, 58	9, 9, 9.9, 10.3	17.2, 17.7, 18.8, 19	38, 39, 39, 40

1590-92 **Phylloscopus inornatus** subspp.

	Wing	*Bill*	*Tarsus*	*Tail*
♂♂				
1590 *humei* (20)	51-60 av. 55.5	7.2-9.8 av. 8	15.5-18 av. 16.8	35-42 av. 40.2
„ B.M. (1)	58	8.8	18.2	41
	(IH 51-61	from skull 10-12	17-19	38-45)
				(BB, HW)
1591 *mandellii* B.M. (4)	54, 56, 58, 59	8.9, 9, 9, 9.8	17.4, 18.4, 18.5, 19.4	39, 40, 41, 45
	(IH As in 1592)			
1592 *inornatus* (11)	53-62 av. 56.9	7.5-9, av. 8.1	14.6-18 av. 16.9	34-46 av. 39.5
„ BM (2)	57, 61	8.3, 10.5	16.9, 18	42, 43
	(IH 55-61	from skull 10-12	17-18	40-44)
				(CBT)

1590-92 **Phylloscopus inornatus** subspp. (contd.)

	Wing	*Bill*	*Tarsus*	*Tail*
♀♀				
humei (11)	52-56 av. 54.2	7.5-9.2 av. 8.1	15.3-17.7 av. 16.1	35-41 av. 39.6
„ BM (3)	52, 54, 56	8.4, 8.5, 9.4	16, 16.1, 16.7	34, 38, 40
	(IH 51-60	from skull 10-12	17-19	37-43)
				(BB, HW)
mandellii (2)	53, 55	7.5, 7.5	17.7, 18	40
	(IH As in 1592)			
inornatus (9)	52-57 av. 53.6	7.8-9.3 av. 8.2	15.3-19.1 av. 16.6	34-40 av. 37.1
„ B.M. (1)	54	9.2	18.3	37
	(IH 51-57	from skull 10-12	17-18	36-41)
				(CBT)
o?				
humei (11)	51-59 av. 55	7.4-8.5 av. 7.9	15.4-17.7	37-42 av. 39.6
mandellii (2)	54, 54	7, 7.5	16.5, 16.8	41, —
inornatus (3)	53, 54, 57	7.4, 7.6, 8	15, 16.3, 17.3	38, 38, 39
„ B.M. (1)	53	9.1	18.4	39

1593 **Phylloscopus subviridis**

♂♂ (9)	49-59-av. 53.8	8-9.6 av. 9.2	14.4-15.9 av. 15.3	36-44 av. 40.2
	(Williamson 49-62	from skull 10-12	16-18	37-47)
♀♀ (3)	51, 52, 53	9, 9.3, 10	14.5, 15.7, 16	39, 40, 40
	(Williamson 49-62	from skull 10-12	16-18	37-47)
o? (3)	52, 53, 57	8.5, 9.6, broken	15, 15.7, 16.6	41, 42, 46

1594/6 **Phylloscopus proregulus** subspp.

♂♂				
1594 *simlaensis* (10)	52-56 av. 53.9	7.2-8.8 av. 8.1	16-18.5 av. 16.8	35-39 av. 37.3
„ B.M. (4)	55, 55, 56, 56	6.3, 7, 7.5, 8.3	14.8, 16, 16.3, 17	38, 39, 39, 40
	(IH measurements as in 1595)			
1595 *chloronotus*,	51	8.9	16.2	40
B.M. (1)	(IH 48-58	from skull 10-11	—	37-44)
				(BB)
1596 *newtoni* (6)	52-56 av. 54.3	6.9-8.5 av. 7.7	16.4-17.8 av. 17	37-41 av. 39.4
	(IH As in 1595			
EL *proregulus* (1)	54	7.7	16.2	38
„ B.M. (3)	53, 56, 56	8, 8.5, 8.7	15.5, 17.4, 17.7	38, 41, 41
	(Williamson ♂♀ 46-57	9-11.5	15.5-18	31-45)

1584/86 **Phylloscopus fuscatus** subspp. (contd.)

	Wing	*Bill*	*Tarsus*	*Tail*
♀♀				
1584 *weigoldi* (2)	57, 62	10.2, 11.2	20.6, 21.4	46, 50
	(IH 53-60	from skull 12-14	21-23	42-49)
			(CBT, Williamson)	
1586 *fuscatus* (4)	53-58 av. 55.2	9.3-10.9 av. 10	18.8-20.9 av. 19.7	43-48 av. 45.2
„ (B.M.) (1)	60	9.6	21.3	54
	(IH 53-61	from skull 12-13	20-22	43-51)
			(Williamson, Hartert)	
o?				
1584 *weigoldi* (4)	51-60 av. 56.4	9.5-10.1 av. 9.8	18-22.2 av. 20.4	44-52 av. 47.8
„ (B.M.) (2)	56, 58	10.3, 10.5	20, 21.9	45, 47

1587-89 **Phylloscopus pulcher** subspp.

	Wing	*Bill*	*Tarsus*	*Tail*
♂♂				
1587 *kangrae* (3)	56, 57, 58	9, 9.3, —	16.2, 17, 17.6	39, 39, 40
	(IH measurements as in 1589)			
1588/9 *pulcher* (5)	55-60 av. 58	9.3-10.5 av. 9.9	17-20.3 av. 18.6	37-42 av. 40.4
	(IH 53-62	from skull 12-13	18-21	40-45)
♀♀				
kangrae (5)	52-59 av. 55.8	8.8-9.7 av. 9	16.4-17.3 av. 16.8	36-41 av. 38
pulcher (2)	52, 54	9.1, 10.3	17.8, 18.5	36, 38
	(IH 52-63	from skull 12-13	18-21	37-42)
o?				
kangrae (2)	54, 56	9, 9	15.6, 17	38, 38
pulcher (4)	53, 54, 56, 58	9, 9, 9.9, 10.3	17.2, 17.7, 18.8, 19	38, 39, 39, 40

1590-92 **Phylloscopus inornatus** subspp.

	Wing	*Bill*	*Tarsus*	*Tail*
♂♂				
1590 *humei* (20)	51-60 av. 55.5	7.2-9.8 av. 8	15.5-18 av. 16.8	35-42 av. 40.2
„ B.M. (1)	58	8.8	18.2	41
	(IH 51-61	from skull 10-12	17-19	38-45)
				(BB, HW)
1591 *mandellii* B.M. (4)	54, 56, 58, 59	8.9, 9, 9, 9.8	17.4, 18.4, 18.5, 19.4	39, 40, 41, 45
	(IH As in 1592)			
1592 *inornatus* (11)	53-62 av. 56.9	7.5-9, av. 8.1	14.6-18 av. 16.9	34-46 av. 39.5
„ BM (2)	57, 61	8.3, 10.5	16.9, 18	42, 43
	(IH 55-61	from skull 10-12	17-18	40-44)
				(CBT)

1590-92 **Phylloscopus inornatus** subspp. (contd.)

	Wing	*Bill*	*Tarsus*	*Tail*
♀♀				
humei (11)	52-56 av. 54.2	7.5-9.2 av. 8.1	15.3-17,7 av. 16.1	35-41 av. 39.6
„ BM (3)	52, 54, 56	8.4, 8.5, 9.4	16, 16.1, 16.7	34, 38, 40
	(IH 51-60	from skull 10-12	17-19	37-43)
				(BB, HW)
mandellii (2)	53, 55	7.5, 7.5	17.7, 18	40
	(IH As in 1592)			
inornatus (9)	52-57 av. 53.6	7.8-9.3 av. 8.2	15.3-19.1 av. 16.6	34-40 av. 37.1
„ B.M. (1)	54	9.2	18.3	37
	(IH 51-57	from skull 10-12	17-18	36-41)
				(CBT)
o?				
humei (11)	51-59 av. 55	7.4-8.5 av. 7.9	15.4-17.7	37-42 av. 39.6
mandellii (2)	54, 54	7, 7.5	16.5, 16.8	41, —
inornatus (3)	53, 54, 57	7.4, 7.6, 8	15, 16.3, 17.3	38, 38, 39
„ B.M. (1)	53	9.1	18.4	39

1593 **Phylloscopus subviridis**

	Wing	*Bill*	*Tarsus*	*Tail*
♂♂ (9)	49-59-av. 53.8	8-9.6 av. 9.2	14.4-15,9 av. 15.3	36-44 av. 40.2
	(Williamson 49-62	from skull 10-12	16-18	37-47)
♀♀ (3)	51, 52, 53	9, 9.3, 10	14.5, 15.7, 16	39, 40, 40
	(Williamson 49-62	from skull 10-12	16-18	37-47)
o? (3)	52, 53, 57	8.5, 9.6, broken	15, 15.7, 16.6	41, 42, 46

1594/6 **Phylloscopus proregulus** subspp.

	Wing	*Bill*	*Tarsus*	*Tail*
♂♂				
1594 *simlaensis* (10)	52-56 av. 53.9	7.2-8.8 av. 8.1	16-18.5 av. 16.8	35-39 av. 37.3
„ B.M. (4)	55, 55, 56, 56	6.3, 7, 7.5, 8.3	14.8, 16, 16.3, 17	38, 39, 39, 40
	(IH measurements as in 1595)			
1595 *chloronotus*, B.M. (1)	51	8.9	16.2	40
	(IH 48-58	from skull 10-11	—	37-44)
				(BB)
1596 *newtoni* (6)	52-56 av. 54.3	6.9-8.5 av. 7.7	16.4-17.8 av. 17	37-41 av. 39.4
	(IH As in 1595			
EL *proregulus* (1)	54	7.7	16.2	38
„ B.M. (3)	53, 56, 56	8, 8.5, 8.7	15.5, 17.4, 17.7	38, 41, 41
	(Williamson ♂♀ 46-57	9-11.5	15.5-18	31-45)

1594/6 **Phylloscopus proregulus** subspp. (contd.)

		Wing	*Bill*	*Tarsus*	*Tail*
	♀♀				
	simlaensis (3)	50, 51, 53	7.7, 8.2, 8.5	15, 16.5, 19	33, 34, 34
		(IH As in 1595)			
	chloronotus BM (2)	49, 50	8.8, 9.3	16.4, 17.2	35, 39
		(IH 46-55	—	—	35-36) (BB)
	newtoni (3)	49, 51, 55	7, 8, 8.7	14.5, 15.6, 15.6	35, 35, 37
		(IH As in 1595)			
	proregulus (1)	54	8.3	17	35
	o?				
	simlaensis (6)	48-56 av. 51.5	8-8.4 av. 8.1	14-16 av. 15.4	31-39 av. 35.3
	chloronotus B.M. (1)	53	—	15.2	38
	newtoni (5)	51-56 av. 53.6	7.5, 7.9, 8.5	14.7-17 av. 16.1	35-40 av. 37.8
	proregulus B.M. (1)	53	8.9	15.5	38

1597/9 **Phylloscopus maculipennis** subspp.

	♂♂				
1597	*virens* (1)	49	8.6	15.7	33
		(IH measurements as in 1599)			
1599	*maculipennis* (7)	48-51 av. 49.8	7-8.3 av. 7.8	15-17.7 av. 16.4	33-35 av. 34
		(IH 48-53	from skull *c.* 10	16-17	32-40) (CBT, Heinrich)
	♀♀				
	virens (2)	45, 47	7.5, 8	15.2, 15.8	32, 34
		(IH measurements as in 1599)			
	maculipennis (1)	48	7.6	16.9	34
		(IH 45-50	from skull *c.* 10	16-17	30-33) (CBT, Heinrich)
	o?				
	maculipennis (1)	48	6.8	16	—

1600 **Phylloscopus borealis borealis**

	♂♂ (2)	66, 66	9.8, —	19, 20.5	44, 45
		(IH ♂♀ 60-70	from skull 13-15	18-21	40-50) (Williamson)

1601 **Phylloscopus magnirostris**

	♂♂ (5)	70-75 av. 71.8	11.3-12.3 av. 11.8	17.4-20 av. 18.4	51-56 av. 53.2
		(IH 62-73	from skull 14-15	19-20	48-56) (BB, HW)
	o? (1)	69	11	20	51

1602-5 **Phylloscopus trochiloides** subspp.

	Wing	*Bill*	*Tarsus*	*Tail*
♂♂				
1602 *viridanus* (35)	56-66 av. 61.1	8.2-11.2 av. 9.8	15.2-20 av. 17.3	41-49 av. 45.6
	(IH 59-65	from skull 12-13	18-19	45-51)
			(CBT, HW)	
1603 *ludlowi* (2)	61, 65	10.1, 10.6	16.9, 19.7	48, 49
	(IH 60-66	from skull 12-13	18-20	45-55)
			(Williamson, HW)	
1604 *trochiloides* (5)	57-65 av. 62.8	10-10.7 av. 10.3	18.5-20 av. 19.3	41-51 av. 47.4
	(IH 62-68	from skull 12-14	18-20	50-57)
			(CBT, BB)	
1605 *nitidus* (12)	57-67 av. 62.3	9-11 av. 9.8	15.9-18.3 av. 17.4	42-47 av. 44.8
	(IH 58-68	from skull 12-14	18-20	45-51)
			(BB, HW)	
♀♀				
viridanus (23)	56-66 av. 59	8.6-11 av. 9.8	15.7-20.5 av. 17.4	39-46 av. 42.7
	(IH 54-65	from skull 12-13	18-19	42-47
			(CBT, HW)	
ludlowi (2)	61, 66	10, 10.5	16.7, 20	47, 48
	(IH 56-60	from skull 12-13	18-20	44-51)
			(Williamson, HW)	
trochiloides (1)	60	10.2	19.4	47
	(IH 55-62	from skull 12-14	18-20	45-52)
			(CBT, BB)	
nitidus (10)	57-67 av. 62.3	9-11 av. 9.8	15.9-18.3 av. 17.4	42-47 av. 44.8
	(IH 58-64	from skull 12-14	18-20	43-47)
			(BB, HW)	
o?				
viridanus (16)	57-64 av. 59.7	8.5-10.9 av. 9.6	15.1-18.8 av. 17	38-47 av. 43.3
ludlowi (4)	58, 59, 61, 62	10, 10.1, 10.6, 10.8	18, 19, 19.5, 20.5	43, 43, 44, —
trochiloides (2)	66, 68	10.3, 10.5	18.2, 20	47, 49
nitidus (4)	62, 62, 63, 66	9.4, 9.7, 10.6, —	16.5, 16.5, 17.2, 18.8	41, 44, 46, 47

1605a **Phylloscopus tenellipes**

	Wing	*Bill*	*Tarsus*	*Tail*
♂♂ (3)	60, 60, 62	10, 10, 10.5	16, 17.6, 18	45, 48, 49
	(IH ♂♀ 55-56	from skull 12-14	18-19	41-50)
			(Williamson)	

1594/6 **Phylloscopus proregulus** subspp. (contd.)

		Wing	*Bill*	*Tarsus*	*Tail*
	♀♀				
	simlaensis (3)	50, 51, 53 (IH As in 1595)	7.7, 8.2, 8.5	15, 16.5, 19	33, 34, 34
	chloronotus BM (2)	49, 50 (IH 46-55	8.8, 9.3 —	16.4, 17.2 —	35, 39 35-36) (BB)
	newtoni (3)	49, 51, 55 (IH As in 1595)	7, 8, 8.7	14.5, 15.6, 15.6	35, 35, 37
	proregulus (1)	54	8.3	17	35
	o?				
	simlaensis (6)	48-56 av. 51.5	8-8.4 av. 8.1	14-16 av. 15.4	31-39 av. 35.3
	chloronotus B.M. (1)	53	—	15.2	38
	newtoni (5)	51-56 av. 53.6	7.5, 7.9, 8.5	14.7-17 av. 16.1	35-40 av. 37.8
	proregulus B.M. (1)	53	8.9	15.5	38

1597/9 **Phylloscopus maculipennis** subspp.

		Wing	*Bill*	*Tarsus*	*Tail*
	♂♂				
1597	*virens* (1)	49 (IH measurements as in 1599)	8.6	15.7	33
1599	*maculipennis* (7)	48-51 av. 49.8 (IH 48-53	7-8.3 av. 7.8 from skull *c.* 10	15-17.7 av. 16.4 16-17	33-35 av. 34 32-40) (CBT, Heinrich)
	♀♀				
	virens (2)	45, 47 (IH measurements as in 1599)	7.5, 8	15.2, 15.8	32, 34
	maculipennis (1)	48 (IH 45-50	7.6 from skull *c.* 10	16.9 16-17	34 30-33) (CBT, Heinrich)
	o?				
	maculipennis (1)	48	6.8	16	—

1600 **Phylloscopus borealis borealis**

	Wing	*Bill*	*Tarsus*	*Tail*
♂♂ (2)	66, 66 (IH ♂♀ 60-70	9.8, — from skull 13-15	19, 20.5 18-21	44, 45 40-50) (Williamson)

1601 **Phylloscopus magnirostris**

	Wing	*Bill*	*Tarsus*	*Tail*
♂♂ (5)	70-75 av. 71.8 (IH 62-73	11.3-12.3 av. 11.8 from skull 14-15	17.4-20 av. 18.4 19-20	51-56 av. 53.2 48-56) (BB, HW)
o? (1)	69	11	20	51

1602-5 **Phylloscopus trochiloides** subspp.

		Wing	*Bill*	*Tarsus*	*Tail*
	♂♂				
1602	*viridanus* (35)	56-66 av. 61.1 (IH 59-65	8.2-11.2 av. 9.8 from skull 12-13	15.2-20 av. 17.3 18-19	41-49 av. 45.6 45-51) (CBT, HW)
1603	*ludlowi* (2)	61, 65 (IH 60-66	10.1, 10.6 from skull 12-13	16.9, 19.7 18-20	48, 49 45-55) (Williamson, HW)
1604	*trochiloides* (5)	57-65 av. 62.8 (IH 62-68	10-10.7 av. 10.3 from skull 12-14	18.5-20 av. 19.3 18-20	41-51 av. 47.4 50-57) (CBT, BB)
1605	*nitidus* (12)	57-67 av. 62.3 (IH 58-68	9-11 av. 9.8 from skull 12-14	15.9-18.3 av. 17.4 18-20	42-47 av. 44.8 45-51) (BB, HW)
	♀♀				
	viridanus (23)	56-66 av. 59 (IH 54-65	8.6-11 av. 9.8 from skull 12-13	15.7-20.5 av. 17.4 18-19	39-46 av. 42.7 42-47 (CBT, HW)
	ludlowi (2)	61, 66 (IH 56-60	10, 10.5 from skull 12-13	16.7, 20 18-20	47, 48 44-51) (Williamson, HW)
	trochiloides (1)	60 (IH 55-62	10.2 from skull 12-14	19.4 18-20	47 45-52) (CBT, BB)
	nitidus (10)	57-67 av. 62.3 (IH 58-64	9-11 av. 9.8 from skull 12-14	15.9-18.3 av. 17.4 18-20	42-47 av. 44.8 43-47) (BB. HW)
	o?				
	viridanus (16)	57-64 av. 59.7	8.5-10.9 av. 9.6	15.1-18.8 av. 17	38-47 av. 43.3
	ludlowi (4)	58, 59, 61, 62	10, 10.1, 10.6, 10.8	18, 19, 19.5, 20.5	43, 43, 44, —
	trochiloides (2)	66, 68	10.3, 10.5	18.2, 20	47, 49
	nitidus (4)	62, 62, 63, 66	9.4, 9.7, 10.6, —	16.5, 16.5, 17.2, 18.8	41, 44, 46, 47

1605a **Phylloscopus tenellipes**

	Wing	*Bill*	*Tarsus*	*Tail*
♂♂ (3)	60, 60, 62 (IH ♂♀ 55-56	10, 10, 10.5 from skull 12-14	16, 17.6, 18 18-19	45, 48, 49 41-50) (Williamson)

1606 **Phylloscopus occipitalis occipitalis**

	Wing	*Bill*	*Tarsus*	*Tail*
♂♂ (20)	58-70 av. 65.1	8.7-12.2 av. 11	15.4-19.4 av. 17.4	42-52 av. 47.3
	(IH 59-71	from skull 13-15	17-19	45-55)
			(Williamson, Koelz, HW)	
♀♀ (10)	59-64 av. 61.4	10.2-12 av. 11.1	15.6-19.4 av. 17.2	42-53 av. 46.2
	(IH 56-70	from skull 13-15	17-19	45-55)
o? (10)	60-69 av. 64.1	10-13 av. 11	16.1-18.7 av. 17.6	45-52 av. 47.8

1608-11 **Phylloscopus reguloides** subspp.

♂♂				
1608 *kashmiriensis* (7)	54-61 av. 57	9.8-10.5 av. 10	16.8-18.8 av. 17.6	43-47 av. 44.5
	(IH ♂♀ 57-65	from skull 13-14	16-17	42-48)
			(CBT)	
1609 *reguloides* (9)	51-58 av. 56.2	8.7-10.6 av. 9.9	15.7-18.3 av. 16.7	40-47 av. 42.7
	(IH ♂♀ 53-62	from skull 11-13	16-18	39-49)
			(Williamson)	
1610 *assamensis* (1)	57	10.3	14.7	45
	(IH measurements as in 1609)			
♀♀				
kashmiriensis (3)	54, 57, 60	9.9, 10.2, 10.3	17.9, 18, 18.5	38, 41, 47
reguloides (2)	52, 58	9.4, 11	17.2, 17.4	38, 39
assamensis (1)	53	8.9	15.7	42
o?				
kashmiriensis (4)	55, 55, 59, 61	9.7, 9.9, 10.5, 11	16.1, 16.5, 16.5, 17.5	39, 43, 44
reguloides (2)	53, 57	11.3, —	15.7, 17.3	38, 42

1612 **Phylloscopus cantator cantator**

♂♂ (2)	52, 56	8.2, 9.7	15.2, 16.5	37, 40
♀♀ (2)	51, 52	9, 10	15, 17	37, 38
	(IH ♂♀ 50-57	from skull 12-13	17-18	35-43)
			(Williamson)	
o? (1)	54	9.4	15.6	41

1613 **Seicercus affinis**

♂♂ (3)	53, 55, 59	9.5, 10.3, 10.5	15, 15, 16.8	41, 42, 44
	(IH ♂♀ 50-58	from skull 11-13	17-19	38-49)
♀ (1)	57	10.2	17.1	44
o? (2)	54, 58	9.7, 10	16.7, 18	42, 43

1614/1615 **Seicercus burkii whistleri/burkii**

	Wing	Bill	Tarsus	Tail
♂♂				
whistleri a (4)	57, 57, 58, 59	10, 10.1, 10.4, —	16.7, 16.9, 17.1, 17.3	45, 46, 47, 48
„ b (2)	55, 57	9.4, 10	16.4, 18	44, 46
burkii (13)	53-58 av. 54.8	9.8-11 av. 10.4	16-20 av. 17.5	41-49 av. 45.3
	(IH 55-61	from skull 13-14	19-20	43-53)
♀♀				
whistleri a (3)	56, 57, —	10.2, 10.5, 10.5	15, 16.4, 17.6	42, 44, —
„ b (1)	53	10.5	16.5	41
burkii (1)	56	9.8	—	41
o?	(IH 51-58	13-14	19-20	43-49)
whistleri (3)	54, 56, 57	10, 10.5, 11	17.1, 17.6, 17.9	42, 43, 47
burkii (5)	53-58 av. 55.8	9.3-10.7 av. 10.2	16.6-17.9 av. 17.3	42-48 av. 44.4
♂♂				

1616-1619 **Seicercus xanthoschistos** subspp.

	Wing	Bill	Tarsus	Tail
1616 *albosuperciliaris* (11)	54-60 av. 58	9.5-11 av. 10.1	15.8-19.5 av. 17.2	40-45 av. 42.4
1617 *xanthoschistos* (12)	51-55 av. 53.1	9-10.6 av. 9.9	16.5-18.2 av. 17.1	38-42 av. 40
1619 *tephrodiras* (1)	46	10	14.7	34
	(51-55	—	—	— Stresemann, SDR)
♀♀				
1616 (8)	53-58 av. 54.6	9.4-10.5 av. 10	16-18.5 av. 17.2	38-44 av. 40.3
1617 (3)	48, 50, 52	9.1, 10.4 (2)	16.2, 16.4, 17	36, 37(2)
	(IH 48-56	from skull 11-13	18-20	39-42)
o?				
1616 (6)	48-61 av. 55.8	9.2-11 av. 9.9	16-18.3 av. 17.4	37-45 av. 42.6
1617 (3)	50, 54, 55	8.9, 9.4, 9.5	15.6 (2), —	37, 42(2)
1619 (2)	49, 51	9.4, —	17, —	35 (2)

1620 **Seicercus poliogenys**

	Wing	Bill	Tarsus	Tail
♂♂ (4)	49, 51, 55(2)	8.4, 8.7, 8.8, 9.7	15.5, 15.7(2), 16.6	39, 42, 44, 45
♀ (1)	52	9.8	16.5	38
	(Baker ♂♀ 50-55	*c.* 9	*c.* 18	40-42)
o? (3)	50, 52(2)	8.3, 9.3, 9.5	14.5, 14.7, 16.4	40, 42, 45

1606 **Phylloscopus occipitalis occipitalis**

	Wing	*Bill*	*Tarsus*	*Tail*
♂♂ (20)	58-70 av. 65.1	8.7-12.2 av. 11	15.4-19.4 av. 17.4	42-52 av. 47.3
	(IH 59-71	from skull 13-15	17-19	45-55)
			(Williamson, Koelz, HW)	
♀♀ (10)	59-64 av. 61.4	10.2-12 av. 11.1	15.6-19.4 av. 17.2	42-53 av. 46.2
	(IH 56-70	from skull 13-15	17-19	45-55)
o? (10)	60-69 av. 64.1	10-13 av. 11	16.1-18.7 av. 17.6	45-52 av. 47.8

1608-11 **Phylloscopus reguloides** subspp.

	Wing	*Bill*	*Tarsus*	*Tail*
♂♂				
1608 *kashmiriensis* (7)	54-61 av. 57	9.8-10.5 av. 10	16.8-18.8 av. 17.6	43-47 av. 44.5
	(IH ♂♀ 57-65	from skull 13-14	16-17	42-48)
			(CBT)	
1609 *reguloides* (9)	51-58 av. 56.2	8.7-10.6 av. 9.9	15.7-18.3 av. 16.7	40-47 av. 42.7
	(IH ♂♀ 53-62	from skull 11-13	16-18	39-49)
			(Williamson)	
1610 *assamensis* (1)	57	10.3	14.7	45
	(IH measurements as in 1609)			
♀♀				
kashmiriensis (3)	54, 57, 60	9.9, 10.2, 10.3	17.9, 18, 18.5	38, 41, 47
reguloides (2)	52, 58	9.4, 11	17.2, 17.4	38, 39
assamensis (1)	53	8.9	15.7	42
o?				
kashmiriensis (4)	55, 55, 59, 61	9.7, 9.9, 10.5, 11	16.1, 16.5, 16.5, 17.5	39, 43, 44
reguloides (2)	53, 57	11.3, —	15.7, 17.3	38, 42

1612 **Phylloscopus cantator cantator**

	Wing	*Bill*	*Tarsus*	*Tail*
♂♂ (2)	52, 56	8.2, 9.7	15.2, 16.5	37, 40
♀♀ (2)	51, 52	9, 10	15, 17	37, 38
	(IH ♂♀ 50-57	from skull 12-13	17-18	35-43)
			(Williamson)	
o? (1)	54	9.4	15.6	41

1613 **Seicercus affinis**

	Wing	*Bill*	*Tarsus*	*Tail*
♂♂ (3)	53, 55, 59	9.5, 10.3, 10.5	15, 15, 16.8	41, 42, 44
	(IH ♂♀ 50-58	from skull 11-13	17-19	38-49)
♀ (1)	57	10.2	17.1	44
o? (2)	54, 58	9.7, 10	16.7, 18	42, 43

1614/1615 **Seicercus burkii whistleri/burkii**

	Wing	*Bill*	*Tarsus*	*Tail*
♂♂				
whistleri a (4)	57, 57, 58, 59	10, 10.1, 10.4, —	16.7, 16.9, 17.1, 17.3	45, 46, 47, 48
„ b (2)	55, 57	9.4, 10	16.4, 18	44, 46
burkii (13)	53-58 av. 54.8	9.8-11 av. 10.4	16-20 av. 17.5	41-49 av. 45.3
	(IH 55-61	from skull 13-14	19-20	43-53)
♀♀				
whistleri a (3)	56, 57, —	10.2, 10.5, 10.5	15, 16.4, 17.6	42, 44, —
„ b (1)	53	10.5	16.5	41
burkii (1)	56	9.8	—	41
o?	(IH 51-58	13-14	19-20	43-49)
whistleri (3)	54, 56, 57	10, 10.5, 11	17.1, 17.6, 17.9	42, 43, 47
burkii (5)	53-58 av. 55.8	9.3-10.7 av. 10.2	16.6-17.9 av. 17.3	42-48 av. 44.4
♂♂				

1616-1619 **Seicercus xanthoschistos** subspp.

	Wing	*Bill*	*Tarsus*	*Tail*
1616 *albosuperciliaris* (11)	54-60 av. 58	9.5-11 av. 10.1	15.8-19.5 av. 17.2	40-45 av. 42.4
1617 *xanthoschistos* (12)	51-55 av. 53.1	9-10.6 av. 9.9	16.5-18.2 av. 17.1	38-42 av. 40
1619 *tephrodiras* (1)	46	10	14.7	34
	(51-55	—	—	— Stresemann. SDR)
♀♀				
1616 (8)	53-58 av. 54.6	9.4-10.5 av. 10	16-18.5 av. 17.2	38-44 av. 40.3
1617 (3)	48, 50, 52	9.1, 10.4 (2)	16.2, 16.4, 17	36. 37(2)
	(IH 48-56	from skull 11-13	18-20	39-42)
o?				
1616 (6)	48-61 av. 55.8	9.2-11 av. 9.9	16-18.3 av. 17.4	37-45 av. 42.6
1617 (3)	50, 54, 55	8.9, 9.4, 9.5	15.6 (2), —	37, 42(2)
1619 (2)	49, 51	9.4, —	17, —	35 (2)

1620 **Seicercus poliogenys**

	Wing	*Bill*	*Tarsus*	*Tail*
♂♂ (4)	49, 51, 55(2)	8.4, 8.7, 8.8, 9.7	15.5, 15.7(2), 16.6	39, 42, 44, 45
♀ (1)	52	9.8	16.5	38
	(Baker ♂♀ 50-55	*c.* 9	*c.* 18	40-42)
o? (3)	50, 52(2)	8.3, 9.3, 9.5	14.5, 14.7, 16.4	40, 42, 45

1621 **Seicercus castaniceps**

	Wing	*Bill*	*Tarsus*	*Tail*
♂♂ (3)	46, 47, 52	7, 7.7, 8.5	14.8, 15.4, 15.6	30, 34, 38
	(IH 48-53	from skull 10-11	16-17	40-43)
♀♀ (4)	46, 49(2), 50	7.5, 8.4, 8.8, 9	14, 15.4, 15.7, 16	36(2), 37(2)
	(IH 47-50	from skull 10-11	16-17	35-38)
o? (4)	47(2), 48, 49	7, 8, 8.5, 8.6	14.3, 15.3(2), 15.6	30, 36(2), 37

1622/23 **Abroscopus superciliaris** subspp.

	Wing	*Bill*	*Tarsus*	*Tail*
♂♂				
1622 *flaviventris* (4)	47, 51, 52, 53	9, 9.3, 9.5(2)	14.5, 15.2, 16.2, 17.8	38, 41, 42, 43
1623 *drasticus* (1)	49	10	16.2	39
	(IH 50-60	from skull 12-13	18-21	39-49)
♀♀				
drasticus (1)	46	9.4	14.5	37
	(IH 46-48	from skull 12-13	18-21	36-40)
o?				
flaviventris (1)	52	9.7	17.3	43
drasticus (3)	46, 47, 51	9, 9.5, 10	15.8, 16.9, 17.1	35, 37, 40

1625 **Abroscopus schisticeps flavimentalis**

	Wing	*Bill*	*Tarsus*	*Tail*
♂♂ (3)	49, 50(2)	8.6, 9.5, —	15.2, 16.1, 17.7	43(2), 44
	(IH 45-49	from skull 10-11	15-17	42-44)

1626 **Abroscopus albogularis**

	Wing	*Bill*	*Tarsus*	*Tail*
♂♂ (2)	45, 48	7.2, 8.1	15.4, 16.8	35, 40
♀♀ (2)	44, 45	8.8, 9.2	14.4, 18	36, 37
	(Baker ♂♀ 43-47	7-8	*c.* 16	36-40)

1627 **Abroscopus hodgsoni**

	Wing	*Bill*	*Tarsus*	*Tail*
♀♀ (2)	44, 66	10.5, 10.6	18, 18.1	37, 42
	(IH 45-49)	from skull 12-14	20-21	38-45)

1628-31 & EL **Regulus regulus** subspp.

		Wing	*Bill*	*Tarsus*	*Tail*
	♂♂				
1629	*himalayensis* (8)	53-57 av. 54.7	7.7-9.8 av. 8.5	15.1-17.2 av. 15.8	32-37 av. 35.3
		(IH ♂♀ 53-58	9-10	*c.* 17	*c.* 36 (Baker)
EL	*japonensis* (1)	59	9.7	15	37
		(Birds of Soviet Union 55-57 av. 55.7)			
	♀♀				
	himalayensis (3)	51, 52, 59	8, 8.5, 8.9	14.1, 16, —	32, 35(2)
	japonensis (1)	54	8.7	—	33
		(Birds of Soviet Union 52-54)			
	o?				
	himalayensis (3)	52, 54, 56	8.1, 8.6, 10.2	15.9, 16.3, 16.8	34, 38, 39

1634 **Leptopoecile sophiae obscura**

	Wing	*Bill*	*Tarsus*	*Tail*
♂ (1)	52	8	18	50
♀ (1)	51	8.5	17.2	50
	(Baker ♂♀ 50-51	about 9	21-23	49-52)
o? (1)	52	7.9	17.2	53

(*to be continued*)

1621 **Seicercus castaniceps**

	Wing	*Bill*	*Tarsus*	*Tail*
♂♂ (3)	46, 47, 52	7, 7.7, 8.5	14.8, 15.4, 15.6	30, 34, 38
	(IH 48-53	from skull 10-11	16-17	40-43)
♀♀ (4)	46, 49(2), 50	7.5, 8.4, 8.8, 9	14, 15.4, 15.7, 16	36(2), 37(2)
	(IH 47-50	from skull 10-11	16-17	35-38)
o? (4)	47(2), 48, 49	7, 8, 8.5, 8.6	14.3, 15.3(2), 15.6	30, 36(2), 37

1622/23 **Abroscopus superciliaris** subspp.

	Wing	*Bill*	*Tarsus*	*Tail*
♂♂				
1622 *flaviventris* (4)	47, 51, 52, 53	9, 9.3, 9.5(2)	14.5, 15.2, 16.2, 17.8	38, 41, 42, 43
1623 *drasticus* (1)	49	10	16.2	39
	(IH 50-60	from skull 12-13	18-21	39-49)
♀♀				
drasticus (1)	46	9.4	14.5	37
	(IH 46-48	from skull 12-13	18-21	36-40)
o?				
flaviventris (1)	52	9.7	17.3	43
drasticus (3)	46, 47, 51	9, 9.5, 10	.15.8, 16.9, 17.1	35, 37, 40

1625 **Abroscopus schisticeps flavimentalis**

	Wing	*Bill*	*Tarsus*	*Tail*
♂♂ (3)	49, 50(2)	8.6, 9.5, —	15.2, 16.1, 17.7	43(2), 44
	(IH 45-49	from skull 10-11	15-17	42-44)

1626 **Abroscopus albogularis**

	Wing	*Bill*	*Tarsus*	*Tail*
♂♂ (2)	45, 48	7.2, 8.1	15.4, 16.8	35, 40
♀♀ (2)	44, 45	8.8, 9.2	14.4, 18	36, 37
	(Baker ♂♀ 43-47	7-8	c. 16	36-40)

1627 **Abroscopus hodgsoni**

	Wing	*Bill*	*Tarsus*	*Tail*
♀♀ (2)	44, 66	10.5, 10.6	18, 18.1	37, 42
	(IH 45-49)	from skull 12-14	20-21	38-45)

1628-31 & EL **Regulus regulus** subspp.

	Wing	*Bill*	*Tarsus*	*Tail*
♂♂				
1629 *himalayensis* (8)	53-57 av. 54.7	7.7-9.8 av. 8.5	15.1-17.2 av. 15.8	32-37 av. 35.3
	(IH ♂♀ 53-58	9-10	c. 17	c. 36 (Baker)
EL *japonensis* (1)	59	9.7	15	37
	(Birds of Soviet Union 55-57 av. 55.7)			
♀♀				
himalayensis (3)	51, 52, 59	8, 8.5, 8.9	14.1, 16, —	32, 35(2)
japonensis (1)	54	8.7	—	33
	(Birds of Soviet Union 52-54)			
o?				
himalayensis (3)	52, 54, 56	8.1, 8.6, 10.2	15.9, 16.3, 16.8	34, 38, 39

1634 **Leptopoecile sophiae obscura**

	Wing	*Bill*	*Tarsus*	*Tail*
♂ (1)	52	8	18	50
♀ (1)	51	8.5	17.2	50
	(Baker ♂♀ 50-51	about 9	21-23	49-52)
o? (1)	52	7.9	17.2	53

(*to be continued*)

COMPARATIVE NOTES ON RHOPALOCERA COMMON TO INDIA AND EAST AFRICA[1]

D. G. Sevastopulo[2]

The following notes on Rhopalocera, common to India and East Africa, may prove of interest. I have treated the term 'India' in its geographical context, not the political, and readers are expected to have a rough general knowledge of the two areas.

It was at one time intended to include my original descriptions and photographs of the larvae of most of the undermentioned species, as well as many others, in Bernard D'Abrera's recently published book BUTTERFLIES OF THE AFROTROPICAL REGION, but unfortunately pressure of time and space prevented this. These descriptions and photographs have now been presented to the British Museum (Natural History).

PAPILIONIDAE

There is no species of Papilionidae common to the two areas, although previously some authors treated *Papilio demodocus* Esp. as a subspecies of *P. demoleus* L. Both species are very much alike in all stages and both are unusual in having three colour forms of pupa—a green and a pink, which are constant in tint, and a brown that varies from dark to pale. The green form of pupa of *P. demodocus* has a diffused, pale mauve, dorsal and lateral stripe, which is lacking in *demoleus*.

P. demodocus occurs all over Africa south of the Sahara, and has one subspecies, *bennetti* Dixey, on the Island of Socotra, whilst nomino-typical *demoleus* occurs over the whole of India to Northern Burma, Sri Lanka, Iran and Arabia; ssp. *malayanus* Wallace occurs in Southern Burma, Thailand and the Malay Peninsula. Other subspecies occur in China, the smaller Sunda Islands and South New Guinea, in Australia ssp. *sthenelus* Macl. occurs. The species is absent from the Philippines, the large Sunda Islands, the Celebes and the Moluccas.

Both species feed on *Citrus* and other Rutaceae, but *demodocus* is also recorded from *Pseudospondias* (Anacardiaceae), *Ptaeroxylon* (Meliaceae), *Hippobromus* (Sapindaceae) and *Bubon* and *Gummifera* (Umbelliferae). The Australian *demoleus sthenelus* feeds mainly on *Psoralea tenax* (Papilionaceae), rarely on *Citrus*, and the mature larva is said to be spotted with orange. Larvae reared in South Africa on an Umbellifer, possibly *Daucus*, are said to have had a peculiar chequered pattern.

I have described the early stages of *demoleus* in the *Bombay Natural History Society Journal*, 41: 311 (1939), 45: 198 (1945) and 46: 576 (1947) and have presented typescript descriptions and photographs of the early stages of *demodocus* to the British Museum (Natural History).

PIERIDAE

Anapheis aurota F.

The nomino-typical form occurs in both areas, the more usual form in East Africa be-

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ing the dry season f. *lordaca* Wlk., with a white underside and narrow well-defined black markings, I have never seen a specimen with the deep chrome yellow underside in East Africa. Ssp. *aurota* also occurs as a straggler in the Nicobar Islands and in Asia Minor. The species does not occur in Assam and Burma. In Sri Lanka it is represented by ssp. *taprobana* Moore, which has more black on the upper side of the forewing and the underside deep chrome yellow. It is a confirmed migrant, sometimes moving in vast swarms.

The description and figure of the early stages (Talbot, FAUNA BRIT. INDIA, *Butterflies*, i, 2nd edit.) applies to both areas. I once found pupae in countless thousands at Mackinnon Road, a scrubby area about fifty miles up the Mombasa/Nairobi road, obviously the progeny of a migrant swarm. All the available Capparidaceae had been stripped of leaves and the pupae were clustered thickly on all suitable twigs, they were side by side and nose to tail and even, in some cases, a second layer formed on top of the first. These pupae were sooty black blotched with white, although the few, still unpupated larvae were normal in appearance. A similar assemblage of pupae found at Qatar (Saudi Arabia) were said to be normal in appearance.

Food-plant: Various species of Capparidaceae. Talbot (loc. cit.) states that the larvae are much subject to parasites, but I have not found this.

I have described the early stages in India in the *JBNHS* 47: 459 (1948) and have presented typescript descriptions and photographs of East African examples to the British Museum (Natural History).

Colotis calais Cr.

Varshney, in a paper entitled "Revised Nomenclature for Taxa in Wynter-Blyth's Book on the Butterflies of Indian Region" (1980, *JBNHS* 76(1): 33-40) considers that the Fabrician name *amata* has priority over Cramer's *calais*, but most authors, including D'Abrera, do not share his views. Peile (A GUIDE TO COLLECTING BUTTERFLIES OF INDIA, 1937) uses *amata.*

The nomino-typical form is found in Africa south of the Sahara but not in the forested areas of West Africa and Zaire, nor in very high areas. It is very common in the Coast Province of Kenya. A separate subspecies, *crowleyi* Sharpe occurs in Madagascar.

Two subspecies occur in India, *modestus* Btlr. in Peninsular India and Bengal and *amatus* F. elsewhere. It is also found in Syria and Iran, Peile (loc. cit.) considers it less common than *protractus* Btlr. and *vestalis* Btlr., but in Kenya it is far the commonest of the Salvadora-feeding species.

Talbot (loc. cit.) describes the early stages of *modestus* and figures the pupa (fig. 157). I have not bred it in India, but have presented typescript descriptions and photographs of the East African early stages to the British Museum (Natural History). The larvae are gregarious and feed on *Salvadora* and *Azima* (Salvadoraceae).

Colotis phisadia Godt.

Ssp. *protractus* Btlr. is found in the drier parts of India, namely Baluchistan, N. W. Frontier, Cutch, Punjab, Sind and Karwar. D'Abrera enumerates no fewer than five subspecies from Africa, two from East Africa, i.e. *vagus* Riley from northern Uganda and northern Kenya, and *rothschildi* Sharpe from southern Uganda and southern and coastal Kenya. Outside our limits the nomino-typical form *phisadia* Godt. occurs in the Somali Republic, Eritrea, northern Ethiopia and Sudan to Chad, Senegal and Mauritania (as well as in Arabia), ssp. *ocella-*

tus Btlr. in Ethiopia and ssp. *somalica* Storace in the Somali Republic. Outside Africa the species occurs from Iran to Palestine.

Talbot (loc. cit.) describes the early stages of *protractus*. I did not breed the species in India but have presented typescript descriptions and photographs of the early stages of *rothschildi* to the British Museum (Natural History). Another *Salvadora*-feeder, but the larva is solitary.

Colotis vestalis Btlr.

The nomino-typical subspecies is found from Sind to Baluchistan, Punjab and Western India, and extends outside our area to the Persian Gulf. The East African subspecies is *castalis* Staud. and occurs in Kenya and Tanzania, outside East Africa it extends to Somalia, southern Ethiopia and the Sudan. I have found it uncommon in Kenya.

Talbot (loc. cit.) describes the early stages but I have not bred it in either India or East Africa. The larva feeds on *Salvadora.*

Colotis danae F.

Two subspecies occur in India, nomino-typical *danae* in Peninsular India and Sri Lanka and ssp. *dulcis* Btlr. in Kathiawar, Sind and Baluchistan. Altogether there are four subspecies in Africa, two in East Africa, ssp. *pseudacaste* Btlr. from Tanzania, Kenya, Uganda and north-eastern Zaire and ssp. *eupompe* Klug from northern Uganda and northern Kenya as well as from Mauritania and Senegal, along the southern fringe of the Sahara to northern Nigeria, Sudan, Ethiopia, the Somali Republic as well as Arabia; outside East Africa ssp. *walkeri* Btlr. occurs in Angola and Namibia and *annae* Wlgrn. in South Africa, Zimbabwe, Mozambique, Botswana, Zambia, Malawi and the Shaba Province of southern Zaire. The species also flies in Iran.

There is considerable seasonal variation and a number of forms, mainly in India, have received names. Generally speaking, the wet season forms have heavier black markings on the upperside and a series of post-discal spots on the hindwing underside. Some extreme dry season forms have the underside tinged with red or pink.

Talbot (loc. cit.) describes the early stages, but the larva and pupa figured on Plate II, figs. 11 & 12 is NOT, repeat NOT, this species but *C. eucharis* F. I did not breed the species in India, but have presented descriptions and photographs of the early stages of ssp. *pseudacaste* to the British Museum (Natural History).

Colotis eucharis F.

The nomino-typical subspecies occurs in India and is found from Central India to Sri Lanka. The East African subspecies is *evarne* Klug and differs little from the Indian, it is found from Senegal to Upper Volta, northern Nigeria, Sudan, Ethiopia, Uganda, Kenya and the Somali Republic. It also occurs in Arabia.

The position was previously complicated by the fact that various forms with a primrose yellow ground colour were considered to be subspecies of *eucharis,* they are now considered to be subspecies of *C. auxo* Lucas, itself previously considered a subspecies of *eucharis*. Personally I have no doubt that this is the correct assessment. Although broadly sympatric, I have never found white and yellow populations occupying the same micro-habitat, I have never seen a yellow female lacking the orange apex of the fore-wing, and, although I have bred many broods from both white and yellow females, I have never had a mixed brood, families have invariably been either all white or all yellow. Both have the same food-plants. However D'Abrera treats *auxo* Lucas from eastern Cape Province to Natal and Transvaal and southern Mozambique as a subspecies of *eucharis.* Outside East Africa ssp. *dissociatus* Btlr., a white form, occurs in Malawi, Zambia, Zimbabwe, Botswana, Northern Mozambique and Tanzania.

The female sometimes occurs lacking the orange apex to the forewing and I have shown that this form is recessive to that with the orange apex (Sevastopulo, 1962, *Entomologist,* 95: 4).

Talbot (loc. cit.) describes the early stages of *eucharis* and stresses the unusual shape of the pupa, but, in spite of this, captions the figures on Plate II, figs. 11 and 12 as *danae* instead of this species. I did not breed this species in India, but I have presented typescript descriptions and photographs of the early stages of *evarne* to the British Museum (Natural History).

Food-plant: *Cadaba* spp. and other species of Capparidaceae.

Colias electo L.

The subspecies found in India is *fieldi* Men., which occurs from Baluchistan to the northern Punjab and Sikkim; it is more common in the western Himalayas and it also extends to north Burma. It varies considerably in size but no white form of female is known from India. The East African subspecies is *pseudohecate* Berger, which occurs in Kenya, Tanzania and Uganda, and also in Malawi, eastern Zaire, Rwanda, Burundi, southern Sudan, southern Ethiopia and northern Somali Republic. It has a white female form f. *aurivilliusi* Kef. The nomino-typical subspecies occurs in South Africa, southern Mozambique, Namibia, Zimbabwe and Zambia south of Kabwe. Other African subspecies are *hecate* Strecker from Angola, southern Zaire, northern Zambia and north-western Malawi, and *meneliki* Berger from central and northern Ethiopia and Eritrea. Outside our limits it is found from Europe to West China, Arabia, Tibet, the Canary Islands and Madiera.

Talbot does not describe the early stages and I have not bred it in either India or East Africa.

Food-plant: Lucerne and other Leguminosae.

Eurema hecabe L.

Five subspecies have been recognised from the Indian subcontinent, *contubernalis* Moore from Bengal to Sikkim, Burma and the Malay Peninsular, *simulata* Moore from Peninsular India, Madhya Pradesh and Sri Lanka, *fimbriata* Wall. from the Punjab to Chitral and Kumaon, *blairiana* Moore from the Andamans and *nicobariensis* Feld. from the Nicobar Islands. The various forms tend to grade into each other, even the island forms. There is a white female form *lacteola* Dist. D'Abrera has recently treated *senegalensis* Bsd. and *floricola* Bsd. as good species, previously considered subspecies of *hecabe,* the former from western Uganda to Congo Republic, Cameroun, Nigeria, Liberia, Sierra Leone and Senegal and the latter from Madagascar, Aldabra Island, Comore Islands, Mauritius and Reunion; he uses the name *solifera* Btlr., from Savannah and woodlands in all the Afrotropical region except the extreme south-west of Cape Province for the sole *hecabe* subspecies in Africa. Outside our limits the species extends over the whole Indo-Australian Region northwards to Korea and Japan and the whole Ethiopian Region.

Talbot (loc. cit.) describes, but does not figure, the early stages and I have described them in this *Journal,* 44: 80(1943). I have also presented typescript descriptions and photographs of the East African early stages to he British Museum (Natural History).

Food-plant: Leguminosae of all three sections.

Eurema brigitta Cr.

Almost as wide-spread as the previous species, covering the whole Ethiopian and Indo-Australian regions and extending to Taiwan and southern China, but far less variable. The single Indian subspecies is *rubella* Wall. The African subspecies is nomino-typical *brigitta,* the dry season form *zeo* Hpffr. has the undersurface sulphur yellow and the fringes are never pink.

Talbot (loc. cit.) describes, but does not figure, the early stages. I have not bred the species in either India or East Africa.

Food-plant: In India it is said to feed on *Cassia kleinii* (Caesalpiniaceae) and probably other Leguminosae. In Africa it is said to feed on *Hypericum* (Hypericaceae).

Catopsilia florella F.

The Indian subspecies is *gnoma* F. but very recently Varshney (loc. cit.) has stated that the correct name for the Indian population is *pyranthe* L. and *florella* is merely the dry season form. Talbot (loc. cit.), whilst treating *pyranthe* and *florella* as two separate species, also suggests that they may be conspecific with *pyranthe* the wet and *florella* the dry form. An extreme dry season form has been named f. *thisorella* Bsd. Ssp. *gnoma* occurs commonly in India, Burma and Sri Lanka and rarely in the Andaman Islands. Nomino-typical *florella* F. occurs all over the Afrotropical Region, unfortunately the yellow female is considered to be the typical form, so that the commoner, male-like female is known as *pyrene* Swains., other female forms are f. *hyblaea* Bsd. with paler, whitish-yellow wings above and f. *aleurona* Btlr. with the wings whitish basally and the distal margin yellow. It now remains to be decided whether the Indian and African populations are conspecific, in which case *florella* falls to *pyranthe* as a synonym. D'Abrera, whose book is the latest on African butterflies, uses *florella.* Outside India and Africa, the *pyranthe*/*florella* complex extends over Arabia, Iran, Indo-China, Hainan, Taiwan, Borneo, Java, the Celebes and Philippines and Australia. It also occurs in the Canary Islands.

Several incomplete breeding experiments appear to indicate that the nomino-typical yellow female form is dominant to the male-like *pyrene.* (Sevastopulo, 1970, *Entomologist,* 103: 70).

Talbot (loc. cit.) describes the early stages and states that the larvae feed gregariously. I have not noticed this in East Africa, and the ova are laid singly, not in batches. Possibly this is another indication that the two populations are not conspecific. I did not breed the species in India but have presented typescript descriptions and photographs of the East African early stages to the British Musuem (Natural History)

If reared indoors in poor light the larvae develop a black lateral stripe, often joined across the dorsum by black bars on the thoracic and posterior somites. If they are fed on Cassia flowers, either yellow or pink, instead of leaves, they are a dull yellow colour but the resulting pupae do not differ from the normal, indicating that the pupal pigment is not a chlorophyll derivative.

Food-plant: *Cassia* spp. and other Caesalpiniaceae.

Pontia glauconome Klug

The species occurs from Baluchistan to the Punjab and Chitral. It is rare. The dry season form has been named *iranica* Biernert. It also extends to Turkestan, Iran, Syria, Arabia and the Island of Socotra. In Africa it occurs in the Somali Republic, Kenya, Ethiopia, Sudan, Chad and probably northern Nigeria. In spite of being normally found in arid areas, I have taken two specimens in the Shimba Hills. Ssp. *distorta* Btlr., described as inhabiting very dry areas in Ethiopia, Somali Republic, Kenya and north-eastern Tanzania, has now been separated as a good species. Nothing appears to have been published about the early stages.

DANAIDAE

Danaus chrysippus L.

There is very little difference between the nomino-typical subspecies found in India and ssp. *aegyptius* Schreber found all over the African continent, the latter being slightly darker and with a narrower pre-apical white band. The major difference between the two subspecies is in the incidence of the two aberrant morphs, *dorippus* Klug and *alcippus* Cr., these are very rare in India but, in some areas, the prevalent forms in Africa, *alcippoides* Moore is a form with less white on the hindwing than *alcippus*. The form *albinus* Lanz, an insect with *dorippus* type of forewing and an *alcippus* hindwing, does not appear to occur in India but is not too uncommon in East Africa. Minor forms are *transiens* Suff., a *dorippus*-like form with the underside of the forewing, and sometimes the upper, with a subapical row of four or five white spots, and *bowringi* Moore with a bigger or smaller white spot in area 2, originally named from Hong Kong. A very rare form, of which I was lucky enough to breed an example in Calcutta, is *amplifascia* Talbot, which has the white subapical band extended inwards to the end of the cell, according to Talbot, only five specimens of this form have been recorded. Broadly speaking, only the *chrysippus* form is found north and south of the tropical zone. In the tropical zone itself, *dorippus* the prevalent form in the east with an admixture of *chrysippus, alcippus* and, more rarely, *albinus,* further west *dorippus* becomes scarcer and finally on the West Coast *alcippus* is the only form.

Outside our limits, the species occurs all over Africa south of the Atlas Mountains, in Arabia and thence throughout tropical Asia to Australia. It is also found in the Canary Islands. The Australian subspecies is ssp. *petilia* Stoll.

f. *dorippus* is dominant to nomino-typical *chrysippus* in East Africa (Sevastopulo, 1976, *Entomologist's Record,* 89: 335). On the other hand f. *alcippus* appears to be recessive; a brood reared from a nomino-typical female produced four f. *chrysippus,* three f. *dorippus,* one f. *alcippus* and three f. *albinus,* no males appeared in this brood (Sevastopulo, 1976, *Entomologist's Record,* 88: 72). It would be interesting to investigate the genetics of Indian *dorippus* and *alcippus.* The species is easy to rear in captivity; females lay freely and, if the leaves provided for laying and feeding are stripped of the underside tomentum to remove tachinid ova, casualties are minimal.

D. chrysippus is the centre of a considerable mimetic complex in both India and Africa. In India *Danaus genutia* Cr. and *D. melanippus* Gray might be considered as not very good Mullerian mimics. The principal Batesian mimics are the females of *Hypolimnas misippus* L. (very good), *Argyreus hyperbius* L. (less good) (Nymphalidae) and *Elymnias hypermnestra* L. (not good) (Satyridae). I know of no day flying moths that mimic *chrysippus* in India. The African complex is much larger and includes the female forms *trophonius* Westw. and *trophonissa* Auriv. of *Papilio dardanus* Brown (Papilionidae), the same two Nymphalid females as in India, also the females of several species of *Euriphene, Bebearia, Euphaedra* and *Charaxes,* and of *Euptera crowleyi* Kirby, *Aterica galene* Brown f. *theophane* Hpffr. and of both sexes of *Pseudacraea deludens* Neave, which also mimics f. *dorippus.*

Among the Lycaenidae, both sexes of several species of *Liptenara, Telipna* and *Mimacraea* are *chrysippus* mimics. All the proceeding are Batesian mimics. *Acraea encedon* L., and a few other *Acraea* spp. are Mullerian mimics, as are presumably the following day flying moths, viz. *Heraclia poggei* Dew. (female only) (Agaristidae) and *Aletis helcita* L., *A. erici* Kirby and *Cartaletis libyssa* Hpffr. (Geometridae). *H. misippus* mimics all three principal forms of the model, as does *A. encedon,* whilst *Mimacraea marshalli* f. *dohertyi* Roths. mimics f. *dorippus,* otherwise f. *chrysippus* is the only model.

D. chrysippus is considered a well-protected species, due to the presence of cardenolides derived from the larval food-plants, but there is a considerable difference in the cardenolide content of the various food-plants and in the storage capacity of the various morphs. f. *alcippus* from the West Coast contains little or no cardenolides, and it is perhaps significant that its only Batesian mimic is the *alcippioides* form of *Hypolimnas misippus,* and that not a very good one. Birds eating *chrysippus* containing cardenolides react by vomiting.

Males of *D. chrysippus,* as all male Danaids, have to ingest pyrrolizidine alkaloids, usually from fermenting *Heliotropium* and *Crotalaria* spp., in order to produce the sex pheromone, in the absence of which females refuse to mate. These alkaloids are also poisonous and undoubtedly add to the distastefulness afforded by the presence of cardenolides, and this may account for the protection of the relatively cardenolide-free *alcippus.*

Talbot [FAUNA OF BRITISH INDIA, *Butterflies,* vol. ii (2nd edit.)] has described the early stages, and I have published descriptions in this *Journal* 1938, 40: 396 and 1946, 45: 190, and have presented typescript descriptions and photographs of the early stages of ssp. *aegyptius* to the British Museum (Natural History).

The larva occasionally produces teratological aberrations. In Calcutta I bred a larva which had additional tentaculae on the left side only on somites 3, 6 to 10 and 12 (Sevastopulo, 1946, *Entomologist,* 79: 90) and in Mombasa I had a brood in which four larvae had additional tentaculae on the somites immediately posterior to those normally bearing them (Sevastopulo, 1974, *Entomologist's Record,* 86: 223). This brood tends to confirm the opinion of the late Dr. E. A. Cockayne, expressed in many of his papers, that some forms of teratological aberration, spiral segmentation for an example, have a genetical basis.

I have found that larvae reared indoors in poor light exhibit a broadening of the black transverse lines.

The female is often very careless when laying, I have found ova on coarse grass, a cultivated Hibiscus and iron fencing wire which were mixed up with a bush of *Calotropis,* and it is doubtful whether the newly hatched larvae would have had the strength to reach their proper food-plant.

The pupa may be green or pink, and there is said to be a wax-yellow form that I have never seen. The pupa is usually formed on the food-plant, when it is green, but there seems to be no direct connection between the colour of the pupa and the substrate on which it is formed (Sevastopulo, 1948, *Proc. R. ent. Soc. Lond.* (A), 23: 93). Two larvae from the same brood can pupate side by side and produce two green pupae, or two pink, or one green and one pink.

Food-plant: Asclepiadaceae of many species, including some of the cactus-like forms, but *Calotropis* spp. is preferred. Pinhey (1949, BUTTERFLIES OF RHODESIA) adds *Rosa* (Rosaceae) and *Antirrhinum* (Scrophulariaceae) the former is almost certainly wrong and the latter a copying error for the Asclepiad *Pentarrhinum*.

Danaus limniace Cr.

Strictly speaking this species should not be included in this paper as *D. petiverana* Dbl. & Hew., previously considered a subspecies of *limniace*, has now been shown to be a true species. Indian examples of *limniace* belong to ssp. *leopardus* Btlr. and are somewhat variable. *D. petiverana* occurs from the Transvaal and Zimbabwe to Ethiopia and the Sudan in the north, to Angola and Ghana in the west. It is occasionally migratory. The nomino-typical subspecies of *D. limniace* was described from China and a number of subspecies have been described from Sri Lanka, the Nicobars and Andaman Islands, Burma to south China, Taiwan, Luzon, the Celebes and Sula Islands, Java, Malaysia and Indo-China.

Both species provide the model for a mimetic complex but, unlike *chrysippus*, the African complex, is much smaller than the Indian. In East Africa the only mimic appears to be *Graphium leonidas* F. and Dr. The Hon. Miriam Rothschild, in a personal communication, has suggested that this may be a Mullerian mimic as the larva feeds on Annonaceae ssp. In India it is the model, to a greater or lesser extent, for a number of *Danaus* species (Mullerian); its Batesian mimics include *Papilio clytia* f. *dissimilis* L., *Graphium macareus* Godt., *G. xenocles* Dbl. and *G. megarus* Westw. (Papilionidae), females of *Valeria valeria hippia* F. (Pieridae), and the Nymphalids *Penthema lisardia* Dbl. and *Parkestina persimilis* Westw. There is another very similar complex based on *Danaus sita* Koll. and the two probably gain some mutual advantage from the rough resemblance between them. Further east it is a member of a very extensive mimetic association.

Dr. A. F. Rosa used the resemblance between the yellow, *philomela* F. female form of *valeria* and *Danaus aspasia* F. as one of the grounds for his hypothesis that mimetic pairs need not be sympatric, but could occur at opposite ends of the range of some migratory insectivorous bird (1937, *Entomologist*, 70: 32). (For a resume of the pros and cons of the case, see Sevastopulo, 1948, *J. Bombay nat. Hist. Soc.*, 47: 559.)

Dr. Richmond Wheeler, in contradiction to Talbot, denies that there is any mimicry between the females of *Valeria* and Danaids (1944, *Entomologist's Record*, 56: 90 and 1945, 57: 45, and Sevastopulo, ibid., 1945, 47: 22 and 47: 105).

The early stages of both species are very much alike, the larva having only two pairs of tentaculae (*chrysippus* has three) and the pupa is always green ornamented with large golden spots. Talbot (loc. cit.) has described the early stages of *limniace*, and I have also described it (as ssp. *mutina* Fruhs.) in this *Journal* (1938, 40: 396 and 1945, 45: 190). My typescript description and photographs of the early stages of *petiverana* have been presented to the British Museum (Natural History).

Food-plant: Asclepiadaceae of various species.

SATYRIDAE

Melanitis leda L.

The Indian subspecies of this wide-spread species is *ismene* Cr., whilst the African is now *helena* Westw. (previously *africana* Fruhs.). The main difference between the two subspecies is the very much more extensive orange patch surrounding the forewing ocellus in the African subspecies. Both subspecies are extremely variable on the underside of the dry season form, but I am of the opinion that there are a number of forms, the very beautiful one with a lavender-brown underside edged with dull orange for example, that occur in India but not in Africa. On the other hand, the difference between the two seasonal forms seems more clear cut in India than in Africa, whence I have a number of examples of the dry season form with quite noticeable ocelli on the underside. The dry season form in India is *ismene* Cr., the wet *determinata* Btlr., the African seasonal forms do not appear to have been named. The species flies at dusk and has often been attracted to artificial light.

Outside our limits, the species extends to Southern Japan, Korea, Southern China and the whole of the Indo-Australian region.

Talbot (loc. cit.) describes the early stages and gives a rather poor outline drawing. I have described the early stages of *ismene* in this *Journal* (1942, 43: 40). My typescript description and photographs of the early stages of *helena* (as *africana*) have been presented to the British Museum (Natural History). There are three forms of larval head capsule, probably genetically controlled.

Food-plant: Grasses and Cereals (Gramineae), it has often been reported as a pest of wheat and rice.

Ypthima asterope Klug

The Indian subspecies of this rather uninteresting small butterfly is *mahratta* Moore, which applies to the wet season form; the dry season form is *alemola* Swinh. It is found all over India. The nomino-typical subspecies occurs all over the Ethiopion Region, where a number of varietal names have been applied to minor aberrations in the number of ocelli on the underside of the hindwing.

Outside our area the range extends to Arabia, Syria and China.

I have not bred the species in India, nor does Talbot give any description of the early stages. My typescript descriptions and photographs of the East African early stages have been presented to the British Museum (Natural History).

Food-plant: Grasses generally (Gramineae).

NYMPHALIDAE

Hypolimnas misippus L.

Whilst specimens from India and Africa both belong to the nomino-typical subspecies, there is a very great difference in the incidence of the various morphs in the two areas. In India, the varietal female form *inaria* Cr., mimicking *Danaus c. dorippus*, and *alcippoides* Btlr., mimicking *D. c. alcippus*, are described as very rare, whilst f. *dorippoides* Auriv., mimicking *D. c. albinus*, does not appear to occur at all, but in Africa all three are common. Whilst the *chrysippus/misippus* complex is sometimes described as a typical example of a model/mimic relationship, this is not altogether correct. There is no correspondence between the frequency or rarity of the various model and mimic morphs in the same area, as an example all four female forms of *misippus* occur on the West Coast but the only *chrysippus* found there is *alcippus*. Again there is considerable variation in the form *inaria* and *alcippoides* in the coloration of the fore-wing apex and the extent of white on the hind-wing respectively. Personally I do not consider this second objection of any real validity; if *Argyreus hyperbius* can be described as a *chrysippus* mimic, these minor variations have no real importance. It has often been stressed that it is the general impression that is important, not a meticulous duplication.

Fruhstorfer, in Seitz' INDO-AUSTRALIAN RHOPALOCERA, uses the name *diocippus* Cr. for the female form having nomino-typical *chrysippus* as its model, but this is usually considered the typical female form of *misippus*.

The genetical relationship between the various morphs does not seem to have been established with any finality.

Outside our area the range extends to Indonesia, Taiwan, China, Japan and Australia, and it has recently colonised the West Indies, South America and the southern United States.

Bingham (FAUNA OF BRITISH INDIA, *Butterflies*, i) gives a brief description of the early stages (Talbot does not cover the Nymphalidae). I did not breed the species in India and my photographs and typescript descriptions of the East African early stages have been presented to the British Museum (Natural History).

Food-plants: *Asystasia, Justicia, Barleria* spp. and other Acanthaceae, *Portulaca, Talima* (Portulacaceae), *Abutilon* (Malvaceae).

When larvae are reared on *Portulaca* spp. care should be taken to place an absorbent pad under the food, otherwise the larvae can quite easily drown themselves in the semi-liquid frass.

Junonia orithya L.

Two subspecies occur in India, ssp. *swinhoei* Btlr., smaller and paler below, from India, Baluchistan and Sri Lanka, and ssp. *ocyale* Hbn., larger and darker below, from Sikkim to Burma. Both are very common. The East African subspecies is *madagascariensis* Guen. and I have not found it common. Generally speaking, it is smaller and paler in dry areas and larger and darker in wet. Another subspecies, *here* Lang, occurs in Arabia. Outside our area the range extends to China (the type locality), the Malayan subregion, Japan and Australia.

Bingham (loc. cit.) gives a brief description of the Indian early stages, and I have described the early stages of *ocyale* in this *Journal* (1941, 42: 748). I have not bred the species in East Africa.

Food-plants: Hygrophilla (Acanthaceae), *Englas scandens* (Labiatae) (this appears to be an unusual abbreviation for *Englerastum*), *Antirrhinum, Striga lutea* (Scrophulariaceae), and in Saudi Arabia Convolvulaceae.

It has been suggested that *Junonia lavinia* Cr., is only an American race of *orithya.*

Junonia hierta F.

Like the preceding species, *hierta* has two subspecies in India. Nomino-typical *hierta*, smaller, from Sri Lanka, India and Baluchistan, and ssp. *magna* Evans, larger and brighter, from Sikkim to Burma and the Andaman Islands. The African subspecies is *cebrene* Trim., from the entire Afro-tropical Region except Madagascar, where it is replaced by ssp. *paris* Trim. Whilst in India *orithya* is considerably commoner than *hierta*, in Africa the reverse is the case and *hierta* outnumbers *orithya* very considerably.

Outside our limits, the species occurs in Arabia, Socotra, Southern China, Hainan, Hong Kong and the Mergui Peninsula.

Bingham (loc. cit.) gives a brief description of the Indian early stages and my photographs and typescript description of the early stages of *cebrene* have been presented to the British Museum (Natural History).

Food-plants: *Asystasia, Barleria, Justicia, Paulowilhelmia, Ruellia* spp. (Acanthaceae).

Vanessa cardui L.

After several changes in the generic name of this butterfly over the last few years, D'Abrera, in his recent book BUTTERFLIES OF THE AFROTROPICAL REGION uses *Vanessa* F.

This cosmopolitan species occurs all over India and Africa, usually more common on higher ground than in the plains, probably because of temperature. Due to its migratory habits it has evolved no subspecies with the exception of ssp. *kershawi* McCoy, from Australia. There are numerous published accounts of migrations in all parts of the world; the only one that I have witnessed personally was in mid-Mediterranean in June 1948, when a number of specimens flew on board the steamer on which I was travelling (1948, *Entomologist,* 81: 186).

Bingham (loc. cit.) gives a brief description of the Indian early stages and I have described them in 1941, in this *Journal* 42: 749. My photographs and typescript description of East African early stages have been presented to the British Museum (Natural History).

Food-plants: *Anchusa, Cyanoglossum, Echium* (Boraginaceae), *Arctium, Arctotis, Artemisia, Carduus, Chrysanthemum, Cirsium, Cynara filage, Gnaphalium, Heliochrysum, Lagera alata, Madia, Pentzia, Senecio, Sonchus, Stobaea* (Compositae), *Althaea, Malva* (Malvaceae), *Argyrolobium, Dolichos, Glycine, Lablab niger, Lupinus, Phaseolus* (Papilionaceae), *Boehmeria, Girardina, Laportea, Urtica* (Urticaceae) and, probably, many others.

Byblia ilithyia Drury

This species, that occurs all over Africa and in Southern and Central India and Sri Lanka, has not developed subspecies. Seasonal variation is very marked and the Indian dry season form has been named *simplex* Btlr. There is also considerable individual variation, but only African varieties appear to have been named.

Bingham does not give any description of the early stages and I have not bred the species in India. but there is a brief description in Seitz' INDO-AUSTRALIAN RHOPALOCERA. My typescript description and photographs of the East African early stages have been presented to the British Museum (Natural History). The early stages of the Eurytelinae are all very much alike and some species are extremely difficult to separate.

Food-plant: *Tragia* and *Dalechampia* spp. (Euphorbiaceae).

The species does not occur outside our limits.

Argyreus hyperbius L.

Strictly speaking, the present species lies outside the range of this paper, but, as it is the only species common to Africa and India and absent from East Africa proper, I have included it.

The African subspecies, *neumanni* Roths. & Jord., is confined to forest margins above 2,100 metres in Ethiopia, and is tawny, not olivaceus, below. Two subspecies occur in India, nominotypical *hyperbius* in the outer ranges of the Himalayas from Cambellpur in the Punjab to Sikkim, Uttar Pradesh, Madhya Pradesh, Manbhum in Bengal, Assam, the Khasi Hills and Upper Burma, and ssp. *castetsi* Ob. in Southern India. Ssp. *taprobana* Moore occurs in Sri Lanka. Ssp. *castetsi* differs from the others in not having a mimetic female, but a race, *hybrida* Evans, from the Nilgiris has both a mimetic and a non-mimetic female. Outside our limits the species extends to China, Taiwan, Sumatra, Java, Japan and Australia.

Bingham (loc. cit.) describes the Indian early stages and I have published a description in this *Journal* 1941, 42: 751.

Food-plant: *Viola* spp. (Violaceae).

Some authors ascribe the specific name to Johannes.

Phalanta phalantha Drury

The nomino-typical subspecies occurs throughout Continental India, Assam, Burma, Tenasserim and Sri Lanka, extending to China, Japan and the Malayan Subregion, it also reaches northern Australia at Darwin (ssp.

araca W. & L.), where it is rare. The African subspecies is *aethiopica* Roths. & Jord. and is found throughout the Afro-tropical Region, including Madagascar, the Seychelles, Aldabra, Comoro and Mascarene Islands, but is absent from south-western Cape Province. Ssp. *granti* Roths. & Jord. is confined to Socotra. Two of what were previously considered to be subspecies of *phalantha* have recently been raised to full specific ranks, these are *P. madagascariensis* Mab. from Madagascar and *P. philiberti* Joannis from Mahe, Praslin and Silhouette Is. in the Seychelles and is thought to be nearing extinction as it has not been collected since 1953.

Bingham (loc. cit.) gives a description of the Indian early stages and I have published descriptions in this *Journal* 1940, 42: 40 and 1947, 46: 577. I have not bred the species in East Africa.

Food-plants: Gymnosporia, Maytenus ovatus (Celastraceae), *Aberia, Dovyalis, Flacourtia* (Flacourtiaceae), *Trimeria* (Samydaceae), *Populus, Salix* (Salicaceae).

LYCAENIDAE

Apharitis acamas Klug

Strictly speaking this species falls outside our terms of reference as the African subspecies —*bellatrix* Btlr. — occurs in the Sudan, Somali Republic and south western Arabia. Two subspecies occur in India, ssp. *hypargyrus* Btlr. from Cutch, Sind, Punjab and Baluchistan, and ssp. *chitralensis* Riley from Chitral, where it is said to be not rare. Outside our limits it occurs in the Palaearctic Region and Algiers. I have not come across the species in either India or Africa. Nothing seems to be recorded about the early stages, but Peile (A GUIDE TO COLLECTING BUTTERFLIES OF INDIA) writes 'In early August the abdomen of almost every female is so distended with eggs as to look like a little ball, Colour of egg white.'

Lycaena phlaeas L.

Three subspecies of *phlaeas* occur in India, ssp. *stygianus* Btlr. from Baluchistan to Chitral and Ladak, *indicus* Evans in the Outer Himalayas, Kashmir to Kumaon, and ssp. *flavens* Ford in the Interior Himalayas to Sikkim. There are three subspecies in Africa, ssp. *abbotti* Holl., occurring in open situations at moderate elevations in Malawi, Tanzania and Kenya, ssp. *aethiopica* Poulton in Alpine areas in the Ruwenzori Mountains and *pseudophlaeas* Lucas in the highlands of Ethiopia. It has been suggested that *abbotti* represents an earlier migration and has separated far enough from the other two subspecies to be considered a good species. Outside our area it occurs throughout Europe, through temperate Asia to Japan and in the eastern states of America.

There appear to be no descriptions of the early stages of the Indian and African subspecies.

Food-plant: *Rumex* spp. (Polygonaceae).

Lampides boeticus L.

This almost consmopolitan species occur all over India and Africa, where it is common, it is rare in the Andamans and Nicobars. It ranges all over the warmer parts of the Old World, reaching Australia, but it does not occur in America. Throughout its vast range it has not formed any subspecies, due to its migratory habits. Some years ago, a correspondent in the United States asked me for living material for experimental purposes, but was refused an import permit, possibly the Authorities were afraid of it becoming a pest.

Bingham (FAUNA OF BRITISH INDIA, *Butterflies*, Vol. ii) describes the early stages and I have published a description in this *Journal*

1938, 40: 399. My photographs and typescript description of East African early stages have been presented to the British Museum (Natural History).

Food-plant: *Cajanus cajan, Canavalia, Colutea, Crotalaria, Indigofera, Lathyrus, Lupinus, Medicago, Phaseolus, Pisum, Podalyria, Sesbania, Sutherlandia, Virgilia* (Papilionaceae), and probably many others. Feeding on the flowers and on unripe seeds in the green pods.

Leptotes pirithous L.

Upto fairly recently the species common to India and East Africa was known as *L. plinius* F., but a review of this very difficult genus has shown that it does not occur in Africa. However, one of the most common components of the complex, *L. pirithous* L., does occur in both Africa and India, as well as in the coastal regions of southern Europe, including all the larger Mediterranean Islands, northward to the southern Alpine slopes and over much of Asia. African species with which it can be confused are *L. babaulti* Stempf. (most of sub-Saharan Africa), *L. brevicaudatus* Tite (most of sub-Saharan Africa), *L. jeanneli* Stempf. (all sub-Saharan Africa) and *L. marginalis* Auriv. (Kenya, Uganda and Sudan). Superficially these species are almost impossible to separate and can only be properly identified by the genitalia. Both *pirithous* and *plinius* occur in India but I do not know whether they are allopatric or sympatric, nor whether any other members of the genus occur in India, A subspecies of *plinius* (?) — *pseudocassius* Murray —occurs in Australia.

Bingham (loc. cit.) gives a brief description of the early stages in India, and my typescript descriptions and photographs of East African early stages have been presented to the British Museum (Natural History) (both as *plinius*).

Food-plant: The varied nature of the food-plant records indicate the confusion in the genus. My own larvae, Bingham's record and the food-plant of *pseudocassius* are *Plumbago* sp. (Plumbaginaceae). Other records are *Burkea, Crotalaria, Indigofera, Medicago, Melilotus, Mundulea, Phaseolus, Pisum, Sesbania* (Papilionaceae). Higgins & Riley (A FIELD GUIDE TO THE BUTTERFLIES OF BRITAIN AND EUROPE), under *pirithous,* give 'small Leguminosae, broom, etc.' Which food-plant belongs to which species in the complex is unclear.

Zizeeria lysimon Hbn.

Some eyebrows may be raised at my inclusion of *Z. lysimon* Hbn. in the present paper, seeing that *Z. knysna* Trim. has been recognised as the correct name for the African population of this composite species for quite a considerable number of years. *Z. knysna* is found over the whole African continent, as well as in Madagascar and the Seychelles, *lysimon* in Southern Europe and in Central and Western Asia, within the Indian zone it occurs in Peninsular India south of the Outer Himalayan Range, Sri Lanka, Burma, Assam, Tenasserim, the Nicobars, and extending through the Malayan subregion to Australia. There seems to be a fairly general difference of opinion over the names of this species. Peile (A GUIDE TO COLLECTING BUTTERFLIES OF INDIA) uses the name *karsandra* Moore, and states that Chapman considers *lysimon* to be African and *karsandra* Asiatic; Common (BUTTERFLIES OF AUSTRALIA) refers to *Z. knysna karsandra,* whilst Bingham states that *karsandra* is a pale aberration of *lysimon.* Seitz, in both INDO-AUSTRALIAN and AFRICAN RHOPALOCERA uses *lysimon,* whilst Evans (IDENTIFICATION OF INDIAN BUTTERFLIES) uses *lysimon.*

Bingham (loc. cit.) gives a brief description of the Indian early stages and my typescript description and photographs of the East African have been presented to the British Museum (Natural History).

Food-plants: Amaranthus (Amaranthaceae), *Euphorbia* (Euphorbiaceae), *Oxalis* (Oxalidaceae), *Medicago, Zornia* (Papilionaceae), *Tribulus* (Zygophyllaceae).

Zizula hylax F.

This species, previously known as *gaika* Trim., occurs throughout Peninsular India, Sri Lanka, Assam, Burma, Tenasserim and the Andamans, and throughout the African continent and Madagascar. Outside our area it occurs in the Malayan Subregion to Sumatra and Java. The Australian subspecies is *attenuata* Lucas. Common (BUTTERFLIES OF AUSTRALIA) gives the distribution as 'throughout world equatorial belt' but in America it is replaced by *Z. cyna* Edwards, with which it has been confused. It seems strange that such small, feeble fliers as this species and the preceding should have such a wide distribution.

The species has a habit of swaying from side to side for a few minutes after alighting.

Pinhey (BUTTERFLIES OF RHODESIA) gives a brief description of the early stages and quotes Murray as saying that the ova are not flattened. I have not bred the species in either India or East Africa.

Food-plant: *Oxalis* spp. (Oxalidaceae), feeding on the flowers.

Azanus ubaldus Cr.

There seems to be some argument over who named this species. Most books cite Cramer as the authority, but d'Abrera cites Stoll as the author.

A butterfly of arid areas, it is found all over India, Burma and Sri Lanka. In Africa it is found in suitable areas from South to East Africa, Somali Republic, across to Senegal and north to Tunisia. It is also found in Tunisia.

I have not bred the species in either India or East Africa, but Piele (A GUIDE TO COLLECTING BUTTERFLIES OF INDIA) states that the larvae are attended by ants and that the pupa is formed in ants' nests.

Food-plant: *Acacia* spp. (Mimosaceae).

Azanus jesous Guerin

Another dry country species, the nomino-typical subspecies occurs throughout Africa. In India it is represented by ssp. *gamra* Led. occurring all over India, Burma and Sri Lanka.

The only description of the larva that I can find is in Pinhey (BUTTERFLIES OF RHODESIA) but he does not say whether it is attended by ants or not. I have not bred the species in either India or East Africa.

Food-plants: *Acacia* spp. (Mimosaceae), *Medicago* (Papilionaceae).

Freyeria trochilus Freyer

Two subspecies occur in India, nomino-typical ssp. *trochilus* from north west India and ssp. *putli* Koll. from south to north-east India, Burma and Sri Lanka. Nomino-typical *trochilus* occurs all over Africa. Outside our limits it occurs in south-eastern Europe, Arabia, Central Asia and through the Malayan subregion to Australia (ssp. *putli*).

The larva, which is attended by ants, has been described briefly by Bingham (loc. cit.) and I have published a description in this *Journal* 1941, 42: 284. I have not bred it in East Africa.

Food-plants: *Heliotropium* spp. (Boraginaceae), *Indigofera* (Papilionaceae).

HESPERIIDAE

D'Abrera does not include this family in his BUTTERFLIES OF THE AFRO-TROPICAL REGION, considering the GRYPOCERA as being of equal status to the RHOPALOCERA and HETEROCERA. In consequence my typed descriptions and photographs of the East African Skippers were not taken to the British Museum (Natural History) by him along with those of East African Butterflies and remain in my possession for the present. I am, therefore, including short descriptions in this paper.

Gomalia elma Trim.

Upto fairly recently the nomino-typical African *elma* and the Indian *litoralis* Swinh. (from Sind and Baluchistan) and *albofasciata* Moore (from Sri Lanka and Southern India to Poona and Kangra) were all considered conspecific. Evans (A CATALOGUE OF THE AFRICAN HESPERIIDAE), however, now states that the genitalia of African *elma* and Indian *albofasciata* differ, implying that they are separate species, but makes no mention of *litoralis* which, presumably, remains a subspecies of *elma*. Outside our limits, the species occurs in Aden and Arabia. I did not meet the species in India, where it is said to be rare. In Africa it is common.

The glaucous green larva has a densely pubescent black head. I have typescript descriptions and photographs, which will be presented to the British Museum (Natural History) at some later date.

Food-plant: *Abutilon* sp. (Malvaceae).

Spialia zebra Btlr.

In Africa, where it is fairly common, this occurs as ssp. *bifida* Higgins. The nomino-typical subspecies occurs in the Western Punjab, where it is said to be rare. Evans (loc. cit.) states that the genitalia of the two subspecies differ slightly. *S. z. bifida* occurs in Kenya and the Southern Sudan.

The yellowish green larva has a black head densely clothed with erect black and whitish setae, forming a round black spot on each cheek and a posterior black band. I have typescript descriptions and photographs, which will be presented to the British Museum (Natural History) at some future date. I did not breed the species in India.

Food-plant: *Melhamia* sp. (Sterculiaceae).

Pelopidas mathias F.

The nomino-typical subspecies occurs all over the Ethiopian Region, Madagascar, the Comoro Islands and Arabia, as well as in India, Burma, Sri Lanka, the Andamans, China, Japan, Taiwan, Malaysia, the Philippines and Celebes.

The blue-green larva has a fine white subdorsal line and the head has a white-edged black or dark red stripe on each cheek. I have typescript descriptions and photographs, which will be presented to the British Museum (Natural History) at some later date. I did not breed the species in India.

Food-plant: Grasses generally (Gramineae).

Pelopidas thrax Hbn.

Formerly considered a subspecies of *mathias*. Occurs all over Africa as ssp. *inconspicua* Bertolini. Nomino-typical *thrax*, which does not occur in the Ethiopian Region, is found in Egypt, Turkey, Cyprus, Syria, Arabia, Aden, Mesopotamia and in India (Cutch, Sind and Southern Punjab).

I have not bred the species in either India or East Africa.

Food-plant: Grasses generally (Gramineae).

Gegenes pumilio Loff.

The nomino-typical subspecies is found in N.W. India, i.e. Baluchistan, Chitral, the Khyber, and the Himalaya foothills to Mussoorie, as well as in Southern Europe, Cyprus, Syria and Mesopotamia. It has been confused with *G. nostrodanus* F., which does not occur in the Ethiopian Region. The African subspecies is *gambica* Mab. occurring over most of the Ethiopian Region.

The grass green larva has a triple dorsal, a double subdorsal and a double lateral darker line. The head is pale green with a white-edged pink stripe on each cheek. I have typescript descriptions and photographs, which will be presented to the British Museum (Natural History) at some later date. I did not breed the species in India.

Food-plant: Grasses generally (Gramineae).

RECORDS OF ODONTOCETES IN THE NORTHERN INDIAN OCEAN (1981-1982) AND OFF THE COAST OF SRI LANKA (1982-1984)[1]

ABIGAIL ALLING[2]

(*With six text-figures*)

Surveys for cetaceans were conducted from a 9 m sloop, s/rv *Tulip* (29 November 1981-12 February 1982) in the northwest Indian Ocean and off the coast of Sri Lanka (13 February-17 March 1982, 20 January-24 April 1983, and 22 February-25 May 1984). Although the principal purpose was to locate and track sperm whales, *Physeter macrocephalus*, observations of other cetaceans were recorded. Odontocetes were observed during the three years in the following relative frequencies (number of observations/number of individuals): spinner dolphin, *Stenella longirostris* (48/1, 804), striped dolphin, *Stenella coeruleoalba* (12/531), spotted dolphin, *Stenella* cf. *Stenella attenuata* (14/656), common dolphin, *Delphinus delphis* (14/711), Risso's dolphin, *Grampus griseus* (37/321), bottlenose dolphins, *Tursiops* sp. (39/477), humpback dolphin, *Sousa* sp. (4/10), false killer whale, *Pseudorca crassidens* (6/43), Fraser's dolphin, *Lagenodelphis hosei* (1/12), pygmy killer whale, *Feresa attenuata* (5/10), Cuvier's beaked whale *Ziphius cavirostris* (1/2), Pilot whale, *Globicephala* cf. *Globicephala macrorhynchus* (3/78), Southern bottlenose whale, *Hyperoodon planifrons* (2/42), and unidentified dolphins (85/664). Behavioural observations and habitat preferences are discussed.

INTRODUCTION

In 1979 members of the International Whaling Commission (IWC) voted to declare the northern portion of the Indian Ocean (20° E-130° E longitude, above 55° S latitude) a marine mammal sanctuary. This international commitment was accompanied with an urgent request that "benign research" of the living whales in the sanctuary be commenced. In response to this request, the World Wildlife Fund-Netherlands (WWF) raised funds for a three year (1982-84) study of sperm whales to be carried out from a 9 m research vessel, s/rv *Tulip*. By agreement with the IWC, the study was also designed to obtain information about the identity, distribution, and relative abundance of all cetaceans sighted. This paper reports on the observations of free ranging odontocetes, other than sperm whales, in the northern portion of the sanctuary from November 1981 through 25 May 1984.

MATERIALS AND METHODS

On 29 November 1981, s/rv *Tulip* sailed from the Suez Canal to begin a survey of cetaceans in the Red Sea and northern Indian Ocean. The vessel arrived in Sri Lanka on 14 February 1982 after stops in Djibouti, Oman, and India (Fig. 1). From 14 February to 17 March 1982, s/rv *Tulip* was used to follow

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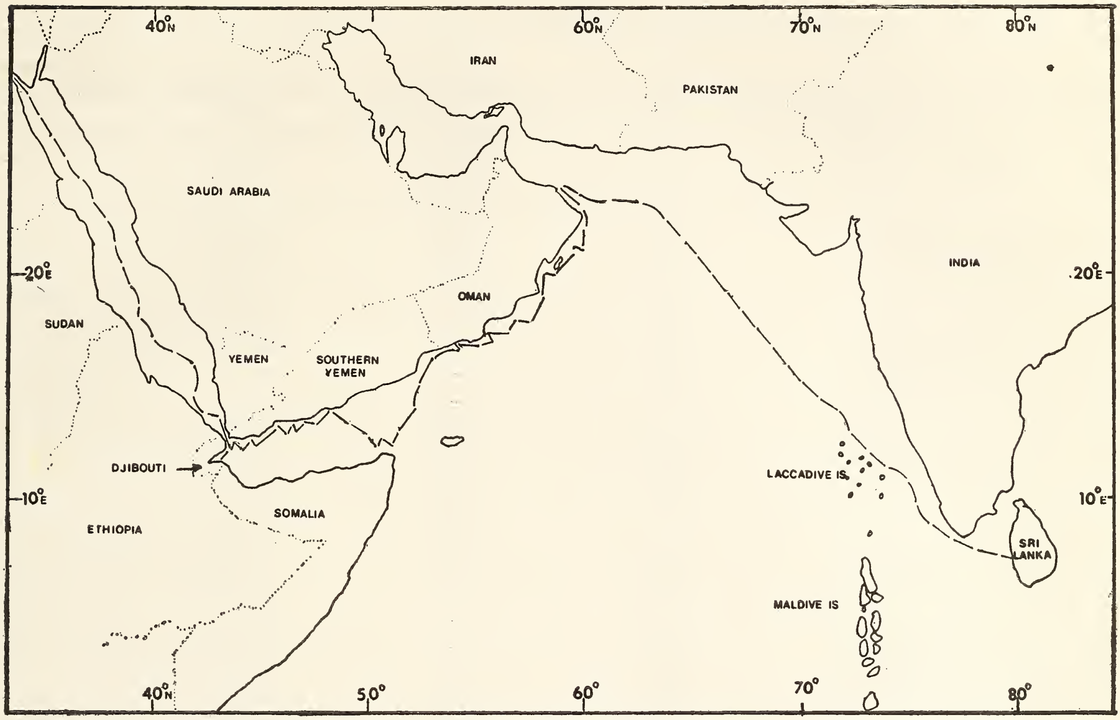


Fig. 1. The route sailed by sr/v *Tulip* 29 November, 1981 through 12 February, 1982.

sperm whales off the west coast of Sri Lanka. During the following two field seasons (20 January-24 April 1983 and 22 February-25 April 1984) the vessel was based at Trincomalee, a harbor on the northeast coast of Sri Lanka, and used to study cetaceans within approximately 100 nm of that port. The research was on sperm, *Physeter macrocephalus* and blue, *Balaenoptera musculus* sp., whales. However, during all field seasons the crew recorded information on all cetaceans sighted.

A constant watch was kept during daylight hours. At least one of five crew members was positioned in the stern of the boat, approximately 3 m above sea level for a maximum three hour watch. When cetaceans were seen the vessel's course was altered to determine species and numbers, but the engine was only used when the speed of the vessel dropped below two knots. Oceanographic variables (e.g. surface water temperature, wind speed, wind direction, etc.) were measured and recorded for each sighting to examine such effects on cetacean distribution and abundance. Surface water temperature was recorded in degrees celsius and depth was monitored up to 1,100 m, the operational limits of the Simrad Skipper 603 depth sounder. Local time, date, and position were obtained from a Tracor Transtar Satellite Navigator.

For this research, a "herd" was defined as a group of cetaceans seen moving in the same direction and at similar speeds. A "sighting" was considered to be an event which began when the first individual became visible and ended when the last was no longer visible.

Table 1

Incidental sightings of small cetaceans recorded in the northern Indian ocean during the spring 1982-1984 field seasons. Rating is recorded as 1=positive, 2=probable, and 3=possible identification

Obs.	Species	Date (Month/Day/Year)	Rating	Lat.	Long.
1	*Delphinus delphis*	120181	3	35 05	23 24
2	*Delphinus delphis*	120381	3	33 14	27 48
3	*Tursiops* sp.	120581	3	31 19	32 21
4	Unidentified Dolphin	121281	3	25 04	35 44
5	Unidentified Dolphin	121281	3	23 46	36 43
6	Unidentified Dolphin	121281	–	23 27	36 49
7	Unidentified Dolphin	121381	–	23 20	36 54
8	*Tursiops* sp.	121381	2	22 18	37 40
9	Unidentified Dolphin	121381	–	22 08	37 48
10	*Tursiops* sp.	121481	2	21 28	37 54
11	*Tursiops* sp.	121481	2	20 21	38 25
12	*Tursiops* sp.	121581	2	19 58	38 38
13	*Pseudorca crassidens*	121581	1	19 31	38 53
14	*Tursiops* sp.	121681	1	17 53	39 07
15	Unidentified Dolphin	121681	–	17 53	39 07
16	Unidentified Dolphin	121681	–	17 38	39 14
17	Unidentified Dolphin	121681	–	17 42	39 17
18	*Tursiops* sp.	121781	2	17 23	39 54
19	*Tursiops* sp.	121781	3	16 44	40 25
20	Unidentified Dolphin	121781	–	16 43	40 28
21	*Tursiops* sp.	121881	2	16 20	41 04
22	*Tursiops* sp.	121881	2	16 06	41 45
23	*Sousa* sp.	122281	3	13 09	43 14
24	*Tursiops* sp.	122381	3	12 12	43 27
25	*Delphinus delphis*	122381	3	12 05	43 25
26	*Delphinus delphis*	122381	3	12 01	43 27
27	*Sousa* sp.	122581	1	11 39	43 08
28	*Pseudorca crassidens*	123081	3	12 11	44 09
29	*Feresa attenuata*	123081	3	12 13	44 15
30	*Grampus griseus*	123081	2	12 13	44 15
31	*Grampus griseus*	123081	1	12 13	44 16
32	*Stenella attenuata*	123081	1	12 24	44 33
33	Unidentified Dolphin	123081	–	12 28	44 40
34	Unidentified Dolphin	123181	–	12 22	45 02
35	Unidentified Dolphin	123181	–	12 39	45 16
36	Unidentified Dolphin	123181	–	12 59	45 44
37	Unidentified Dolphin	10182	–	13 05	46 06
38	*Tursiops* sp.	10182	1	13 14	46 28
39	Unidentified Dolphin	10382	–	13 19	48 24
40	*Delphinus delphis*	10382	3	13 07	49 01
41	*Tursiops* sp.	10382	2	12 25	51 07

TABLE 1 (contd.)

42	*Tursiops* sp.	10582	2	12 29	51 11
43	*Stenella longirostris*	10682	2	13 35	51 50
44	Unidentified Dolphin	10882	–	15 59	52 47
45	*Grampus griseus*	10882	2	16 05	52 48
46	Unidentified Dolphin	10882	–	16 05	52 48
47	Unidentified Dolphin	10882	–	16 08	52 52
48	*Grampus griseus*	10882	2	16 14	52 58
49	*Grampus griseus*	10882	2	16 16	52 57
50	*Tursiops* sp.	10982	3	16 42	53 41
51	*Stenella longirostris*	10982	1	16 45	54 11
52	*Grampus griseus*	10982	1	16 48	54 26
53	Unidentified Dolphin	10982	–	16 57	54 47
54	*Sousa* sp.	11082	1	16 56	54 00
55	*Sousa* sp.	11182	1	16 56	54 00
56	*Delphinus delphis*	11382	1	16 58	54 29
57	*Stenella longirostris*	11382	2	16 53	54 12
58	*Delphinus delphis*	11382	3	16 58	54 29
59	*Delphinus delphis*	11482	1	17 18	55 24
60	*Delphinus delphis*	11482	1	17 19	55 27
61	*Delphinus delphus*	11482	3	17 19	55 27
62	*Delphinus delphis*	11582	1	17 18	55 28
63	*Delphinus delphis*	11582	1	17 21	55 27
64	Unidentified Dolphin	11582	–	17 20	55 27
65	Unidentified Dolphin	11782	–	17 23	55 42
66	Unidentified Dolphin	11982	–	18 13	57 42
67	*Stenella longirostris*	11982	3	18 49	57 47
68	*Feresa attenuata*	12082	2	19 17	58 11
69	Unidentified Dolphin	12082	–	19 21	58 16
70	Unidentified Dolphin	12082	–	19 46	58 27
71	*Ziphius cavirostris*	12382	1	22 15	59 55
72	*Grampus griseus*	12482	1	23 15	59 11
73	*Tursiops* sp.	12482	1	23 15	59 10
74	*Feresa attenuata*	12482	3	23 24	58 59
75	Unidentified Dolphin	12882	–	22 47	60 41
76	*Tursiops* sp.	12982	2	22 37	62 47
77	*Tursiops* sp.	12982	2	22 37	62 29
78	*Tursiops* sp.	12982	3	22 34	62 31
79	Unidentified Dolphin	13082	–	22 29	62 46
80	Unidentified Dolphin	20482	–	16 32	68 27
81	Unidentified Dolphin	20482	–	16 20	68 42
82	*Stenella coeruleoalba*	20582	3	15 50	69 12
83	Unidentified Dolphin	20782	–	13 37	72 30
84	*Pseudorca crassidens*	20882	3	11 51	72 56
85	*Stenella longirostris*	20982	1	10 53	75 12
86	*Grampus griseus*	20982	3	10 41	75 17
87	Unidentified Dolphin	20982	–	10 41	75 17
88	Unidentified Dolphin	20982	–	10 25	75 25
89	Unidentified Dolphin	21082	–	10 25	75 27
90	*Pseudorca crassidens*	21082	3	10 25	75 27

TABLE 1 (contd.)

91	Unidentified Dolphin	21082	–	10 15	75 28
92	Unidentified Dolphin	21082	–	10 23	75 29
93	*Stenella longirostris*	21082	2	10 23	75 30
94	*Stenella attenuata*	21082	1	10 12	75 34
95	Unidentified Dolphin	21082	–	08 22	76 28
96	Unidentified Dolphin	21082	–	08 21	76 30
97	*Tursiops* sp.	21282	3	07 39	77 38
98	Unidentified Dolphin	21282	–	07 29	77 52
99	Unidentified Dolphin	21282	–	07 23	77 59
100	Unidentified Dolphin	21282	–	07 29	77 56
101	Unidentified Dolphin	21282	–	07 20	77 59
102	*Stenella attenuata*	21982	2	06 21	79 40
103	*Stenella coeruleoalba*	21982	1	06 21	79 40
104	Unidentified Dolphin	22082	–	05 47	80 14
105	Unidentified Dolphin	22082	–	05 47	80 14
106	Unidentified Dolphin	22282	–	05 51	80 13
107	*Stenella longirostris*	22282	2	05 47	80 07
108	Unidentified Dolphin	22282	–	05 54	79 54
109	*Stenella coeruleoalba*	22382	1	06 23	79 38
110	*Stenella coeruleoalba*	22382	1	06 30	79 38
111	*Delphinus delphis*	22382	1	06 30	79 38
112	*Delphinus delphis*	22482	1	07 42	79 29
113	Unidentified Dolphin	22582	–	08 14	79 34
114	*Stenella longirostris*	22782	1	07 58	79 00
115	*Grampus griseus*	30182	1	07 17	79 40
116	*Stenella longirostris*	30182	1	07 32	79 34
117	*Stenella longirostris*	30182	1	07 32	79 37
118	*Stenella coeruleoalba*	30782	1	07 36	79 24
119	*Stenella longirostris*	30782	1	07 34	79 21
120	*Stenella coeruleoalba*	30782	1	07 38	79 22
121	Unidentified Dolphin	30882	–	08 03	79 17
122	Unidentified Dolphin	30882	–	08 00	79 32
123	Unidentified Dolphin	30982	–	08 03	79 33
124	Unidentified Dolphin	30982	–	08 06	79 26
125	*Stenella coeruleoalba*	30982	1	08 06	79 20
126	*Grampus griseus*	31082	1	08 04	79 34
127	*Grampus griseus*	31182	1	08 17	79 36
128	Unidentified Dolphin	31182	–	07 53	79 36
129	*Stenella longirostris*	31182	3	07 50	79 36
130	Unidentified Dolphin	31282	–	07 16	76 38
131	*Tursiops* sp.	31282	1	07 01	79 47
132	*Tursiops* sp.	31382	1	07 00	79 45
133	*Stenella longirostris*	31382	1	06 59	79 44
134	*Stenella longirostris*	31382	1	07 00	79 41
135	Unidentified Dolphin	31482	–	07 30	78 00
136	Unidentified Dolphin	12183	–	08 39	79 24
137	*Tursiops* sp.	12283	1	08 49	78 38
138	Unidentified Dolphin	12283	–	08 49	78 35
139	*Tursiops* sp.	12483	3	07 40	78 00

TABLE 1 (contd.)

140	*Tursiops* sp.	12883	1	06 15	79 50
141	*Stenella attenuata*	12883	1	06 07	79 50
142	*Tursiops* sp.	12883	1	06 00	79 53
143	*Stenella longirostris*	12883	1	06 00	79 53
144	*Stenella longirostris*	12983	1	05 52	80 18
145	*Tursiops* sp.	12983	3	05 52	80 20
146	*Stenella longirostris*	12983	1	05 33	80 22
147	*Stenella longirostris*	13083	3	06 16	82 02
148	*Tursiops* sp.	13083	1	06 16	82 07
149	*Tursiops* sp.	13183	1	06 33	81 57
150	Unidentified Dolphin	13183	–	06 44	82 06
151	Unidentified Dolphin	20183	–	06 37	82 05
152	*Tursiops* sp.	20183	2	06 38	82 02
153	*Lagenodelphis hosei*	20283	3	06 26	81 53
154	Unidentified Dolphin	20283	–	06 19	81 48
155	*Grampus griseus*	20383	1	06 23	81 49
156	Unidentified Dolphin	20383	–	06 22	81 50
157	*Tursiops* sp.	20583	3	07 00	82 04
158	*Pseudorca crassidens*	20683	2	07 38	82 01
159	*Grampus griseus*	20683	1	07 54	82 01
160	*Feresa attenuata*	20683	3	07 53	81 54
161	*Grampus griseus*	21583	1	08 42	81 23
162	*Stenella coeruleoalba*	21683	1	08 43	81 20
163	*Grampus griseus*	21883	1	08 36	81 28
164	*Stenella longirostris*	21983	1	08 35	81 22
165	*Stenella longirostris*	30283	1	08 39	81 19
166	Unidentified Dolphin	30783	–	08 26	81 42
167	*Grampus griseus*	30783	1	08 28	81 46
168	Unidentified Dolphin	30783	–	08 33	81 41
169	*Stenella longirostris*	30883	1	08 21	81 51
170	*Stenella coeruleoalba*	30983	1	08 12	82 02
171	Unidentified Dolphin	30983	–	08 07	82 06
172	*Stenella attenuata*	31083	2	08 08	82 08
173	Unidentified Dolphin	31083	–	08 09	82 12
174	*Tursiops* sp.	31183	2	08 29	82 16
175	Unidentified Dolphin	31183	–	08 31	82 08
176	Unidentified Dolphin	31283	–	08 36	81 54
177	*Stenella longirostris*	31283	1	08 34	81 39
178	*Stenella attenuata*	31283	1	08 34	81 39
179	Unidentified Dolphin	31883	–	08 54	81 57
180	Unidentified Dolphin	32083	–	07 53	82 12
181	Unidentified Dolphin	32083	–	07 53	82 21
182	*Globicephala macorhynchus*	40583	1	09 22	81 03
183	Unidentified Dolphin	40683	–	09 54	80 58
184	*Stenella longirostris*	40983	3	09 46	80 58
185	*Stenella longirostris*	41083	1	09 46	80 52
186	*Stenella longirostris*	41083	1	09 46	80 54
187	Unidentified Dolphin	41083	–	09 39	80 59
188	Unidentified Dolphin	41183	–	09 28	81 34

TABLE 1 (contd.)

189	*Hyperoodon planifrons*	41183	2	09 28	81 34
190	*Pseudorca crassidens*	41183	1	09 28	81 34
191	*Grampus griseus*	41283	1	08 45	81 18
192	Unidentified Dolphin	41283	–	08 28	81 12
193	*Stenella longirostris*	41883	1	08 35	81 22
194	Unidentified Dolphin	42083	–	07 41	82 17
195	*Tursiops* sp.	42183	1	07 47	82 25
196	Unidentified Dolphin	42183	–	07 47	82 25
197	*Tursiops* sp.	42183	1	07 48	82 25
198	*Stenella coeruleoalba*	42283	1	08 05	81 59
199	Unidentified Dolphin	42283	–	08 02	81 55
200	*Stenella longirostris*	21884	1	05 51	81 02
201	*Stenella coeruleoalba*	21984	3	06 15	81 45
202	*Stenella longirostris*	22084	1	07 12	82 11
203	*Feresa attenuata*	30384	3	08 36	81 21
204	*Stenella attenuata*	30684	1	08 38	81 30
205	*Stenella longirostris*	30684	1	08 38	81 30
206	*Stenella attenuata*	30784	2	08 35	81 25
207	*Stenella longirostris*	30784	1	08 36	81 27
208	*Stenella longirostris*	30884	1	08 36	81 25
209	Unidentified Dolphin	30884	–	08 36	81 26
210	*Stenella longirostris*	31184	2	08 33	81 16
211	*Globicephala macrorhynchus*	31184	2	08 35	81 31
212	*Tursiops* sp.	31184	1	08 35	81 30
213	*Grampus griseus*	31284	2	09 12	81 12
214	*Grampus griseus*	31384	1	09 32	81 10
215	*Grampus griseus*	31384	1	09 38	81 08
216	*Grampus griseus*	31384	1	09 40	81 05
217	*Grampus griseus*	31384	1	09 41	81 07
218	*Stenella longirostris*	31384	1	09 40	81 06
219	*Stenella longirostris*	31384	3	09 35	81 06
220	*Stenella longirostris*	31484	2	09 28	80 55
221	Unidentified Dolphin	31484	–	09 29	80 56
222	*Grampus griseus*	31484	1	09 35	80 58
223	*Stenella longirostris*	31484	2	09 31	80 56
224	Unidentified Dolphin	31484	–	09 28	80 57
225	*Grampus griseus*	31584	1	09 33	81 04
226	*Grampus griseus*	31584	1	09 32	81 04
227	*Grampus griseus*	31584	1	09 32	81 04
228	*Grampus griseus*	31684	1	09 02	81 08
229	*Grampus griseus*	31684	1	09 04	81 07
230	*Grampus griseus*	31684	1	09 03	81 09
231	*Grampus griseus*	31684	1	09 04	81 10
232	*Grampus griseus*	31684	1	09 08	81 11
233	*Grampus griseus*	31684	1	09 08	81 12
234	*Stenella longirostris*	31684	1	09 10	81 12
235	*Stenella attenuata*	31684	1	09 10	81 12
236	Unidentified Dolphin	31784	–	08 57	81 19
237	*Stenella longirostris*	31784	1	08 42	81 19

TABLE 1 (contd.)

238	Unidentified Dolphin	31784	–	08 40	81 18
239	*Stenella longirostris*	31784	1	08 38	81 21
240	*Grampus griseus*	31784	3	08 36	81 23
241	*Stenella longirostris*	31984	1	08 36	81 22
242	*Grampus griseus*	32484	1	08 01	81 59
243	Unidentified Dolphin	32584	–	08 27	81 34
244	*Stenella longirostris*	32584	2	08 35	81 23
245	*Stenella coeruleoalba*	32584	2	08 35	81 23
246	*Grampus griseus*	32884	1	08 54	81 16
247	*Grampus griseus*	32884	1	08 53	81 15
248	*Grampus griseus*	32884	1	08 55	81 15
249	Unidentified Dolphin	33084	–	09 28	80 55
250	Unidentified Dolphin	33184	–	09 25	81 00
251	*Stenella longirostris*	40184	2	09 05	81 06
252	*Stenella attenuata*	40184	1	08 54	81 13
253	*Stenella longirostris*	40884	1	09 27	80 58
254	*Stenella attenuata*	40884	2	09 27	80 58
255	Unidentified Dolphin	40884	–	09 27	80 51
256	*Stenella longirostris*	40884	1	09 28	80 57
257	*Stenella attenuata*	40984	1	09 24	80 59
258	*Stenella longirostris*	41084	1	09 28	80 58
259	*Stenella attenuata*	41084	3	09 33	80 59
260	*Tursiops* sp.	41184	1	08 33	81 16
261	*Tursiops* sp.	41684	1	.. ..	.. ..
262	*Stenella longirostris*	41684	3	.. ..	.. ..
263	*Tursiops* sp.	41684	1	.. ..	.. ..
264	*Stenella longirostris*	41784	1	.. ..	.. ..
265	*Tursiops* sp.	41784	1	08 35	81 23
266	*Stenella longirostris*	41784	1	08 35	81 22
267	*Hyperoodon planifrons*	42384	3	09 43	80 52
268	Unidentified Dolphin	42484	–	09 33	80 57
269	Unidentified Dolphin	42484	–	09 31	80 56
270	*Globicephala macrorhynchus*	42584	1	09 10	81 07
271	*Stenella attenuata*	42584	1	09 10	81 07

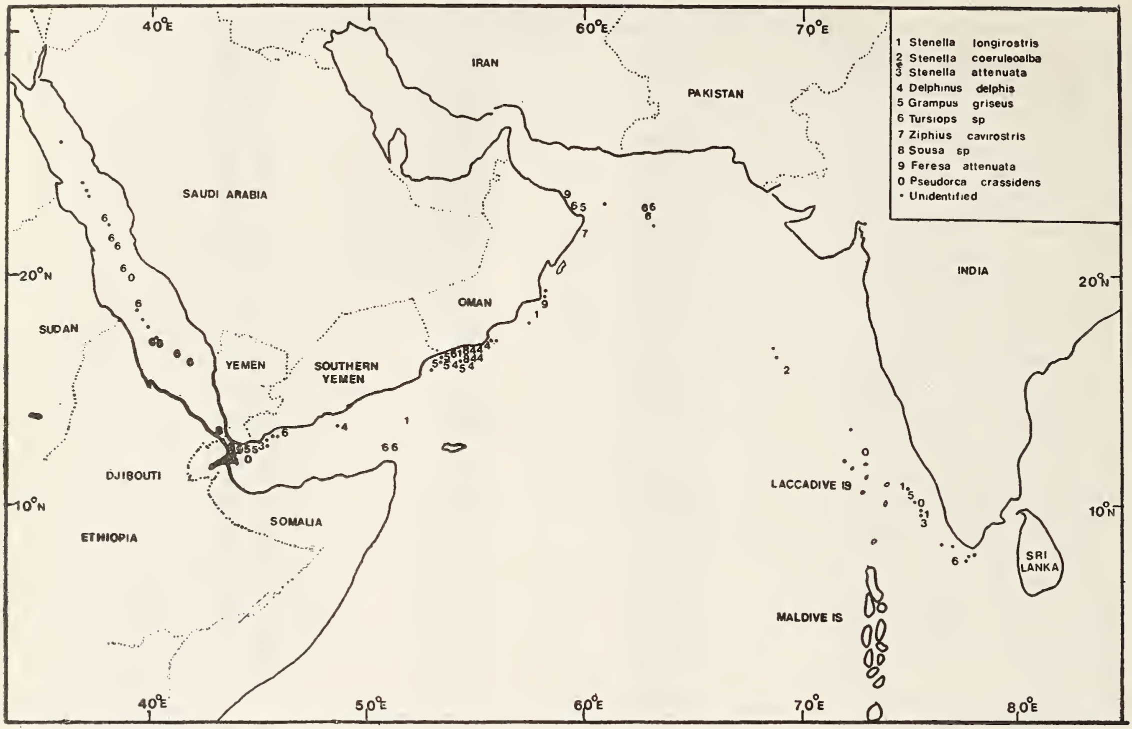

1 Stenella longirostris
2 Stenella coeruleoalba
3 Stenella attenuata
4 Delphinus delphis
5 Grampus griseus
6 Tursiops sp
7 Ziphius cavirostris
8 Sousa sp
9 Feresa attenuata
0 Pseudorca crassidens
• Unidentified
40°E
60°E
70°E
50°E
80°E
20°N
10°N
IRAN
PAKISTAN
SAUDI ARABIA
INDIA
OMAN
SUDAN
YEMEN
SOUTHERN YEMEN
DJIBOUTI
ETHIOPIA
SOMALIA
LACCADIVE IS
SRI LANKA
MALDIVE IS

Fig. 2. Sightings of odontocetes in the northern Indian Ocean, 29 November, 1981 through 12 February, 1982.

Each sighting was comprised of a herd. Some herds contained smaller sub-sets called "groups." Groups could be distinguished because animals in them moved in close coordination with one another and were often in clusters, spatially distinct from one another.

Observations of herd or individual behaviour are summarized by species. Informal estimates were made of the number of animals in a herd and their speed of movement. Animals were photographed with 35 mm Canon cameras and photographs were analysed later to confirm species identity. A flash was used at night to photograph individuals riding-the-bow. Sightings are listed in Table 1, along with codes indicating confidence in identification (1 = positive, 2 = probable, and 3 = possible identification).

Results and Discussion

There were 135 sightings in 1982 (Figs. 2 & 3), 64 in 1983 (Fig. 4) and 72 in 1984 (Fig. 5). The frequency (number of observations/number of individuals) with which each species was seen is shown in the three year period is listed in Table 2. In six sightings, multi-species herds were involved. As there were no means to assess the degree of interaction between such species or to determine how long they were actually in contact, each species was recorded separately. A total of 3,818 minutes was spent observing animals, but

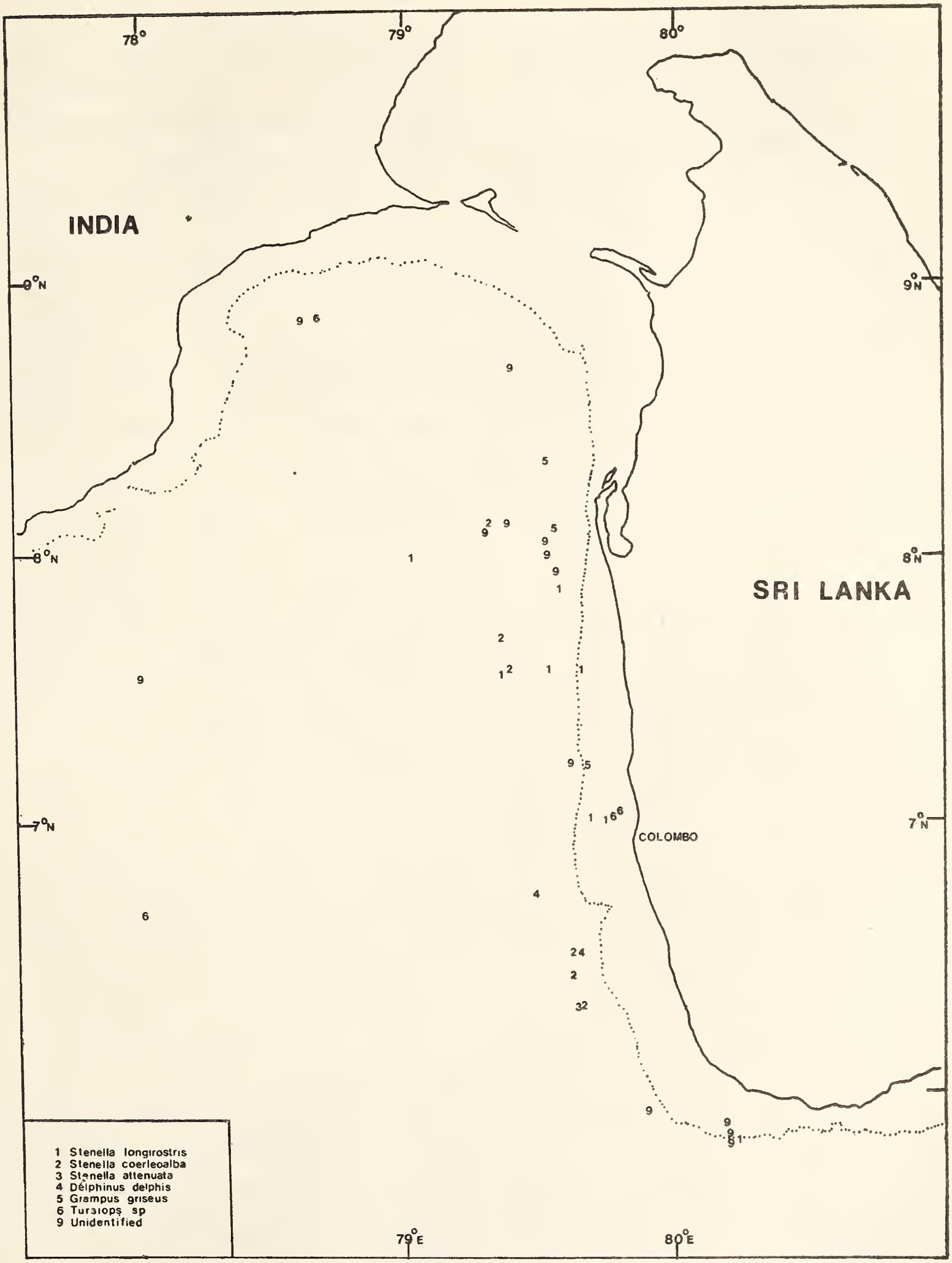

78°
79°
80°
INDIA
SRI LANKA
COLOMBO
9°N
8°N
7°N
79°E
80°E
1 Stenella longirostris
2 Stenella coerleoalba
3 Stenella attenuata
4 Delphinus delphis
5 Grampus griseus
6 Tursiops sp
9 Unidentified

Fig. 3. Sightings of odontocetes off the west and southwest coasts of Sri Lanka, 13 February through 17 March, 1982. The dotted line represents the 1,000 m depth contour.

Table 2

The frequency with which odontocetes were observed during the 1982, 1983 and 1984 field seasons

Species	number of observations/number of individuals
spinner dolphin	48/1804
striped dolphin	12/531
spotted dolphin	14/656
common dolphin	14/711
bottlenose dolphin	39/477
Risso's dolphin	37/321
humpback dolphin	4/10
false killer whale	6/43
pygmy killer whale	5/10
Fraser's dolphin	1/12
Cuvier's beaked whale	1/2
Southern bottlenose whale	2/42
pilot whale	3/78
unidentified dolphin	85/664

Table 3

Observations in which a herd was observed with one or more calves during the three year study

Species	Jan.	Feb.	March	April
spinner dolphin	29/83	09/84 11/84 18/84	01/82 07/82 13/82 02/83 06/84 08/84 16/84	01/84 08/84
striped dolphin		23/82	07/82 09/83	22/83
spotted dolphin	28/83	10/82	12/83	01/84 06/84 16/84
common dolphin	14/82 14/82 15/82 15/82			
bottlenose dolphin	01/82 05/82 29/82		13/83	21/83 11/84 16/84 17/84
Risso's dolphin	09/82 24/82	15/82		
Pilot whale				11/84 25/84

encounters were generally brief. There were 33 occasions when the animals were followed for at least 30 minutes. Forty-eight observations occurred at night when animals rode-the-bow. Cetacean distribution has been linked to water temperatures and currents in the Indian Ocean (Nishiwaki 1983), but the temperature of the surface water proved too homogeneous to be used in this manner. All sightings occurred within 21°7′C and 31°2′C. Depth was not recorded for all sightings in 1984 because the depth sounder was broken. Calves were seen various times and places (Table 3). Animals were considered a "calf" if they were accompanied by an individual which appeared to be at least twice its size.

Following Keller *et al.* (1982), two indices of abundance were calculated for cetaceans seen on December 25 1981 to February 12 1982 from s/rv *Tulip* (Table 4). The transects covered an estimated 3,300 nm (6,111 km) between Djibouti and Sri Lanka. Indices of abundance were not calculated for the time spent in the Red Sea because a constant watch was not kept due to rough weather.

Systematic Accounts

Striped dolphins

Striped dolphins, *Stenella coeruleoalba*, were seen 12 times off the coasts of Oman, India, and Sri Lanka in waters greater than 1,100 m deep. During 33% of the sightings animals came to the bow, but overall they seemed uninterested in our presence. For all sightings, individuals within a herd appeared to be

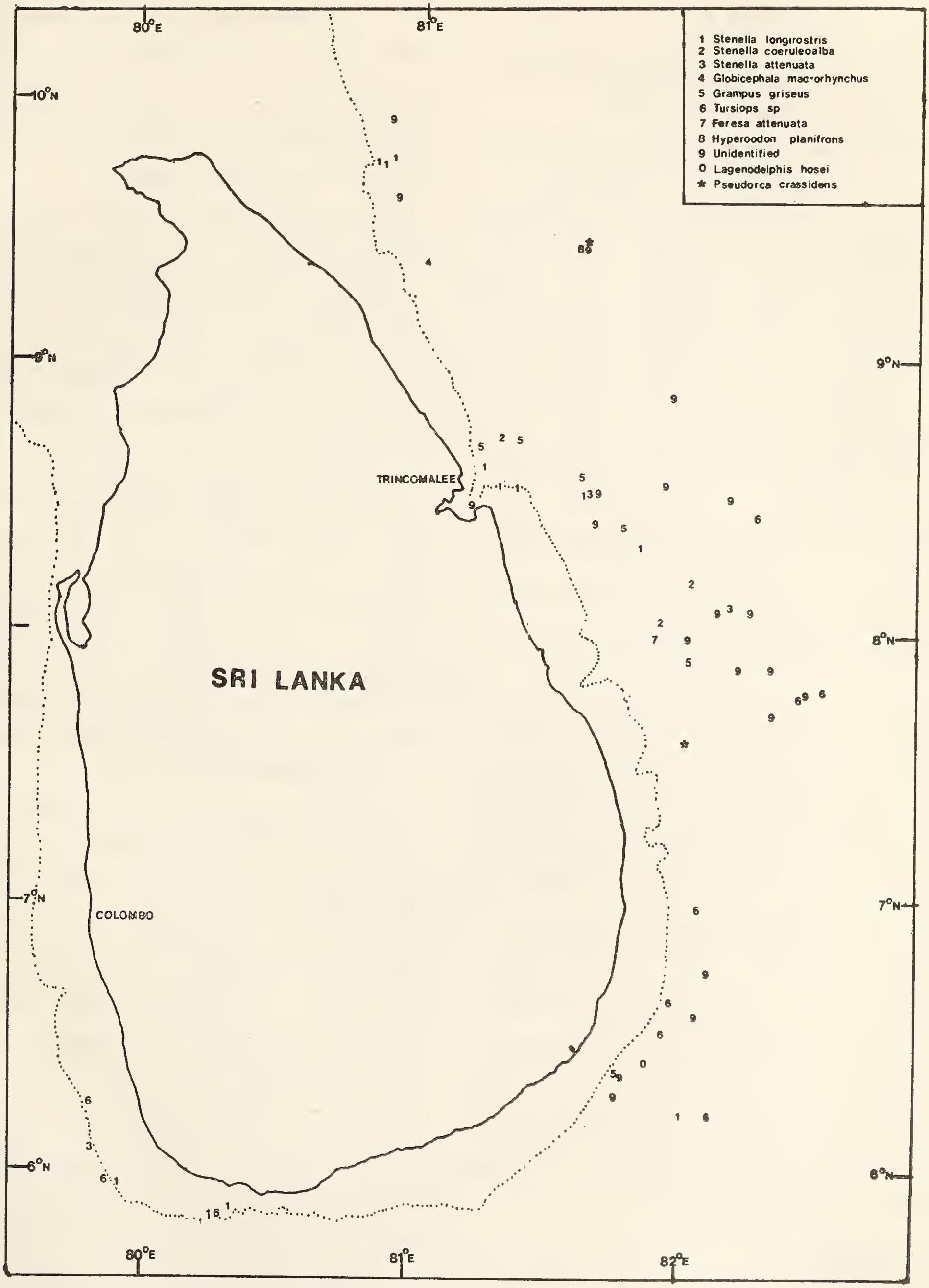

1 Stenella longirostris
2 Stenella coeruleoalba
3 Stenella attenuata
4 Globicephala macrorhynchus
5 Grampus griseus
6 Tursiops sp
7 Feresa attenuata
8 Hyperoodon planifrons
9 Unidentified
0 Lagenodelphis hosei
★ Pseudorca crassidens
80°E
81°E
82°E
10°N
9°N
8°N
7°N
6°N
SRI LANKA
TRINCOMALEE
COLOMBO

Fig. 4. Sightings of odontocetes off the east and south coasts of Sri Lanka, 20 January through 24 April, 1983. The dotted line represents the 1,000 m depth contour.

TABLE 4

INDICES OF ABUNDANCE OF ODONTOCETES IN THE NORTHERN INDIAN OCEAN, DECEMBER 25, 1981 THROUGH FEBRUARY 12, 1982

Species	number of sightings	I_1	number of individuals	I_2
spinner dolphin	6	0.18	427	13.0
striped dolphin	1	0.03	3	0.09
spotted dolphin	2	0.06	100	3.0
common dolphin	8	0.24	573	17.4
Risso's dolphin	8	0.24	101	3.1
bottlenose dolphin	11	0.34	82	2.43
humpback dolphin	3	0.09	9	0.3
false killer whale	3	0.09	5	0.03
pygmy killer whale	2	0.06	9	0.3
Cuvier's beaked whale	1	0.03	2	0.06
unidentified dolphins	33	1.0	327	9.9
TOTAL	78	2.4	1,638	49.7

I_1 = number of sightings/100 nm.
I_2 = number of individuals/100 nm.

dispersed often as distances as great as a mile. Herd size varied, but 48% of the herds contained 6 to 50 animals (Fig. 6). Aerial activity included "humping", a jump where the dolphin's nose and fluke remain in the water and a "head-first-reentry" jump in which the dolphin leaves the water returning nose first (Wursig and Wursig 1980). "Head-slaps", "back-slaps", "leaps", and "tail-over-head" leaps were also seen (Norris and Dohl 1980a). The first three such jumps are self explanatory. The last named jump is one in which the animal leaves the water and then brings its tail over its head and returns to the water tail first. While off Sri Lanka in February, March, and April, calves were occasionally seen.

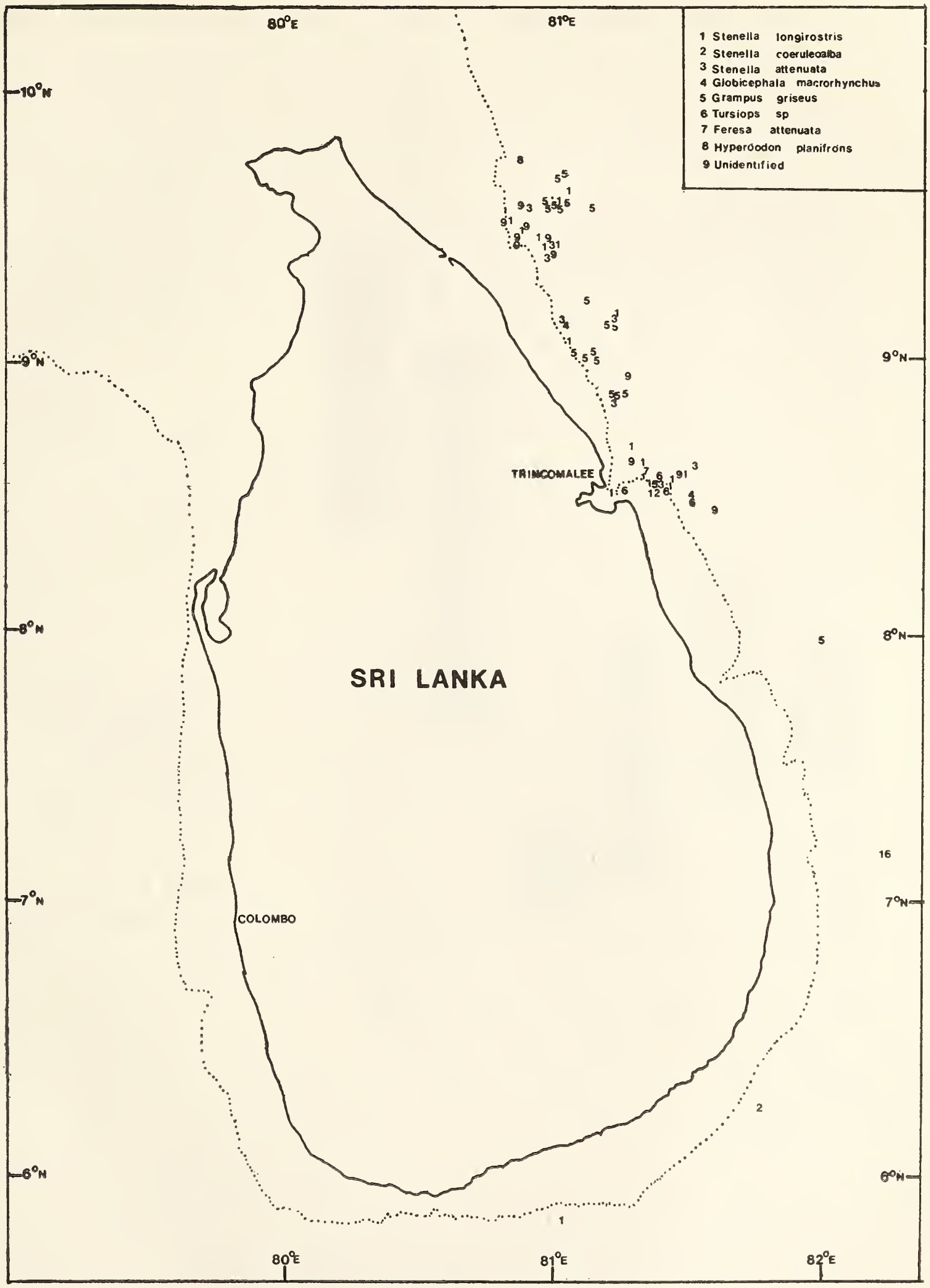
Spinner dolphins

Forty-eight herds of spinner dolphins, *Stenella longirostris,* were sighted along the coasts of Oman, India and Sri Lanka. Of these herds, 62% contained fewer than 50 animals (Fig. 6), 62% occurred at depths which were less than 1,000 m, and 32% contained animals which rode-the-bow. Calves were seen 13 times between January and March.

We had little success in observing or filming animals underwater. Once, however, a herd of 15 spinner dolphins approached s/rv *Tulip* while some of the crew were in the water. Initially the dolphins were engaged in aerial activity, but by the time they reached us, they had slowed down or remained motionless. Three of the animals seemed to be interacting. Two of the animals (escorts) alternately stroked the body of the third (focal animal) with their beaks. Periodically one of the two escorts would turn its belly towards the focal animal. During the seven minutes that dolphins were observed, the hydrophones were monitored on a Uher recording system. Initially as the animals swam towards s/rv *Tulip* squeals were heard, but by the end of the observation period the herd appeared to be silent.

Generally, spinner dolphins seemed to avoid our boat or to be uninterested in its presence. Aerial activity included the "spin" (Norris and Dohl 1980a), leap, back-slap, tail-over-head leap, humping, head-first-re-entry jump, and a somersault in which the animals flipped several times about a horizontal axis. During one sighting off the coast of Sri Lanka when Little terns, *Sterna albifrons,* were with a herd of dolphins, one dolphin leapt out of the water to snatch a flying fish from the beak of a tern. On another occasion, a large fish, possibly tuna, *Thunnus* sp., was jumping out of the water in the middle of a school of spinners.

Four races of *Stenella longirostris* are found in the Pacific Ocean : 1) Costa-Rican spinner, 2) eastern spinner, 3) white-belly spinner, and


80°E
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5 Grampus griseus
6 Tursiops sp
7 Feresa attenuata
8 Hyperöodon planifrons
9 Unidentified
SRI LANKA
TRINCOMALEE
COLOMBO

Fig. 5. Sightings of odontocetes off the east coast of Sri Lanka, 22 February through 25 May, 1984. The dotted line represents the 1,000 m depth contour.

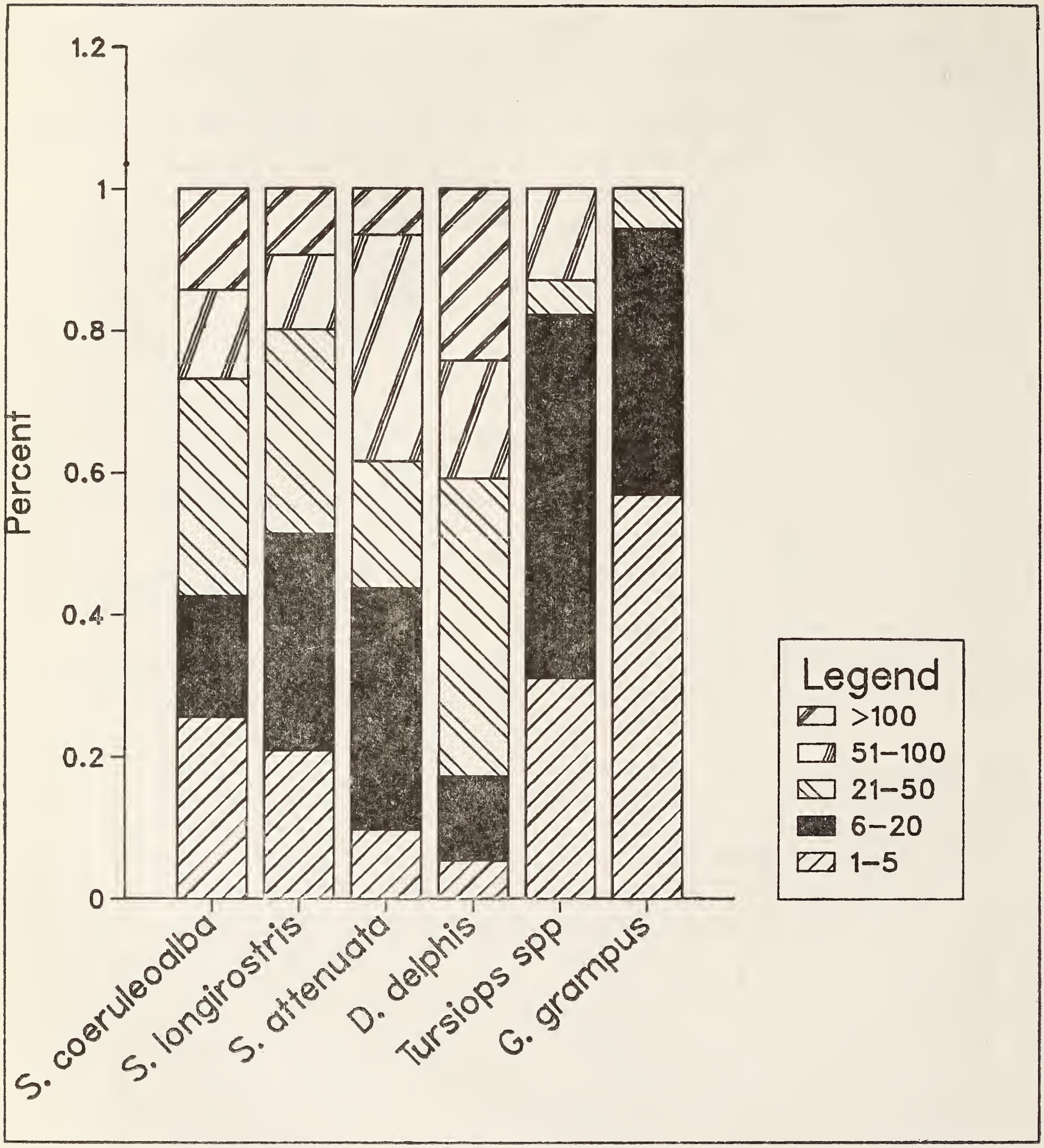

Fig. 6. Proportions of herds by herd, size for all species.

4) Hawaiian spinner (Perrin 1975). Spinner dolphins seen in the Indian Ocean were all similar to the Hawaiian race, except for those seen of the west coast of Sri Lanka. These animals had a distinct stripe running from the anus along their side, gradually terminating near the anterior insertion of the flipper. This lateral line has been observed on spinner dolphins found in the Gulf of Aden, tentatively referred to as a distinct race (Robineau 1983).

Spotted dolphins

Spotted dolphins *Stenella* cf. *Stenella attenuata,* were seen once during the day off Oman, once while bow-riding at night off the coast of India and 12 times off the coast of Sri Lanka.

Herd size varied from 7 to 200 individuals, but 44% of the schools contained fewer than 20 individuals (Fig. 6). Aerial activity included head-first-re-entry jumps, humping, head-slaps, and leaps. Individuals came to the bow during 57% of all sightings. Calves were seen off India in February and off Sri Lanka in January and March.

Common dolphins

Common dolphins, *Delphinus delphis,* were seen in the Red Sea, off the coasts of Djibouti and Oman, and in the Gulf of Mannar. Sixty-four percent of these groups seen contained individuals that did not come to the bow of s/rv *Tulip* and 57% of the sightings were at depths over 1,000 m. Estimates of group size varied from 3 to 200 animals, but 42% were composed of 21-50 individuals (Fig. 6).

Aerial activity was not as varied as that observed in *Stenella* species, but animals frequently would leap over 2.8 m high or jump out of the water, landing on their backs. Calves were seen in January.

Bottlenose dolphins

There were 39 sightings of bottlenose dolphins, *Tursiops* sp., distributed in all waters at depths varying from 15 to over 1,100 m. Of these herds, 62% were seen at depths between 100-1,000 m, 51% were composed of 6-20 animals (Fig. 6), and 64% contained individuals that rode-the-bow.

On 17 April 1984 at 1415, we followed a herd of bottlenose dolphins for 45 minutes. This herd appeared to be composed of three groups of 10-15 animals each. The groups remained below the surface of the water for approximately two minutes and then surface for about two minutes with continual aerial activity. Head-first-re-entry jumps, back-slaps, head-slaps, leaps and tail-slaps were seen. In particular, we noticed that three animals (possibly the same individuals) repeatedly leaped out of the water together in a high circular arc approximately every 25 seconds.

Risso's dolphins

There were 37 sightings of Risso's dolphins, *Grampus griseus,* off the coasts of Oman, India, and Sri Lanka. Fifty-three percent of all sightings were made in depths over 1,000 m, but herds were seen at depths as shallow as 100 m. Fifty-seven percent of all sightings were composed of herds containing fewer than five animals (Fig. 6). Herds were sometimes spread out over 1,000 m with groups of 2-15 animals that remained coordinated.

Aerial activity included head-slaps, tail-slaps, and leaps. Like whales, these animals also were seen breaching, fluking when diving, and spy-hopping. In spy-hopping, animals bring their head entirely or partially out of the water. Three times animals spy-hopped facing s/rv *Tulip,* suggesting that they were curious about our vessel, but they generally did not show interest in our boat. Once while diving with them, we saw approximately 50 animals appear about 6-9 m below us in groups of two or three.

Fraser's dolphins

Fraser's dolphins, *Lagenodelphis hosei,* were possibly seen once off the east coast of Sri Lanka in February. The depth was greater than 1,100 m and they were travelling at approximately 2-4 knots. The group of 12 animals did not seem interested in our boat and animals were only seen humping except for an occasional head-first-reentry jump.

Humpback dolphins

Humpback dolphins, *Sousa* sp., were seen four times outside Djibouti Harbor and in Salalah Harbor, Oman. One of the crew (Hal Whitehead) watched three animals herd fish schools into a shallow shoreline in the harbor. Similar behavior has been observed with bottlenose dolphins (Leatherwood 1975, Norris and Dohl 1980b, Hoese 1971).

Medium sized whales

Two Cuvier's beaked whales, *Ziphius cavirostris,* were seen off the coast of Oman at a depth of about 850 m. Animals appeared to have white backs with scars on the dorsal surface. Animals did not fluke while diving.

Two unidentified beaked whales were seen off the coast of Oman in waters deeper than 1,000 m. They did not fluke, but backs were arched when diving. From the distance their color appeared black and they averaged about 5.4 m in overall length.

Hyperoodon planifrons, southern bottlenose whales were tentatively identified off the east coast of Sri Lanka on 11 April 1983 and possibly again on 23 April 1984. In the first sighting, the whales were spread out over approximately 800 m, and 40 animals were arranged in groups of ten while travelling at a speed of 4-7 knots. Estimated lengths were from 5.6 m to 7.8 m, and animals appeared cream colored, with a pronounced bulbous head. The groups travelled in horizontal formations and no flukes were seen when the animals dove.

Pygmy killer whales, *Feresa attenuata* were seen once off the coast of Oman and five times off Sri Lanka in waters 120 m to 1,000 m deep. All animals sighted were seen in groups of less than six individuals and animals generally travelled slowly, avoiding s/rv *Tulip.*

False killer whales, *Pseudorca crassidens,* were seen on six occasions off Oman, India, and Sri Lanka and in the Red Sea in depths greater than 300 m. Animals in the Red Sea rode-the-bow, but during all other sightings, groups seemed to take no interest in our vessel.

Pilot whales, *Globicephala* cf. *Globicephala macrorhynchus,* were seen three times off the east coast of Sri Lanka. On 5 April 1983, members of s/v *Tulip* were in the water with sperm whales when eight pilot whales swam under 12 sperm whales. During the other two sightings, pilot whales were seen in herds of 50 and 20 animals while moving at about two to four knots.

Mixed herds

Herds containing mixed species were rarely recorded, but it is likely that the crew of s/rv *Tulip* simply did not notice both species when individuals were travelling rapidly in large herds. Different herds of dolphins which were seen in close proximity to one-another occurred more frequently. Risso's dolphins were seen in close proximity to sperm whales, bottlenose dolphins, pygmy killer whales, and false killer whales. Southern bottlenose whales, unidentified dolphins, and false killer whales were seen in the same vicinity on 6 February 1983 and pilot whales were seen with sperm whales on 5 April 1983. The extent that herds associate spatially or temporally is not known.

Mixed herds of dolphins included spinner and spotted dolphins, spinner and common dolphins, spinner and striped dolphins, and striped and common dolphins. These sightings are described below:

1. A mixed herd of over 200 spinner dolphins and spotted dolphins was followed for 40 minutes (0815-0855) on 12 March 1983. Spinners were bunched into tight groups, with little aerial activity. The spotted dolphins were organized into looser groups and much aerial activity was seen including leaps, head-slaps, head-first-re-entry jumps, and head-over-tail leaps. Tuna were seen jumping out of the water among these animals.
2. On 6 March 1984 a mixed herd of about 35 animals were encountered at (0815-0830). There was little aerial activity except for Head-first-re-entry jumps and occasional tail-slaps and leaps.
3. On 16 March 1984, a group of 75 animals was followed from 1625 to 1705. Among the entire herd, head-first-re-entry jumps, back-slaps, head-slaps, leaps and spins were seen. The spotted dolphins rode the bow, but the spinner dolphins did not. In addition, 175 birds were seen surrounding the school. Species which were identified by one of the crew (N. Davies) included *Sterna bergii,* Crested terns, *Anous stolidus,* Brown noddy terns, *Sterna anaethetus,* Bridled terns, and possibly *Sterna bengalensis,* Lesser crested terns and *Sterna dougallii,* Roseate tern.
4. At 1252 on 13 January 1982, more than 100 common dolphins were seen with spinner dolphins. There was little aerial activity and the herd, which was initially travelling in a long line, seemed to spread out forming small groups.
5. Striped and common dolphins were seen together on 23 February 1982, at 0950. The herd was divided into sub-groups of about six animals spread out over a distance of approximately one mile. The groups travelled at speeds as great as 15 knots.
6. Striped and spinner dolphins were seen in a mixed herd on 25 March 1984 at 1730. All animals were moving at about 10 knots in a horizontal line.

ACKNOWLEDGEMENTS

I thank Peter Lagendijk, Khamish Al Farsi, Dr. Lex Hiby, Dr. Roger Payne, Cedric Martenstyn, Nihal de Abrew, Elizabeth Kemf, Rosemarie Sommers, and Leslie Joseph for their assistance on s/rv *Tulip* as visiting scientists. The National Aquatic Resource Agency of Sri Lanka generously helped to facilitate our work in Sri Lanka without their help and encouragement the study would not have been possible. I am most grateful to Stephen Leatherwood, Dr. William Perrin, and Dr. James Mead who analyzed photographs of animals to confirm their identification and Stephen Leatherwood, Dr. Bernd Wursig, Dr. Patricia Moehlman, Dr. Allison Richards, and Dr. John Rhoads for their comments or review of the manuscript. Above all, I thank the Captains, Dr. Hal Whitehead and Jonathan Gordon, and crew of s/rv *Tulip,* Nic Rotten, Martha Smythe, Margo Rice, Nick Davies, Phil Gilligan, and Vassilli Papastavrou. The study was funded by the World Wildlife Fund-Netherlands.

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NEW DESCRIPTIONS

A NEW SPECIES OF GENUS *ERISTALIS* LATREILLE (SYRPHIDAE: DIPTERA)[1]

AWTAR SINGH, N. S. SODHI AND VIPUL GUPTA[2]

(*With seven text-figures*)

INTRODUCTION

There did not exist any significant contribution on the systematics of Indian Syrphidae until the publication of FAUNA OF BRITISH INDIA by Brunetti (1923). He (1923) described about 267 species from the Indian subcontinent. Subsequently, Blair (1948), Coe (1964), Nayar (1967a, 1967b) and Ghorpade (1981) added a few more species to the syrphid fauna of the Indian subcontinent. A study of the syrphid fauna of North-West India was taken up and this paper describes a new species.

Eristalis yamunanagarensis sp. nov.

MALE.

Head: face yellow with concolorous tomentum and silvery white hair, raised centrally into a black knob; clypeus black; mouth opening bottle-shaped, proboscis black; genae yellow with concolorous hair, post genae with silvery white tomentum; frons yellow with concolorous tomentum and yellow hair; antennae fulvus, arista orange coloured, bare; eyes brown, with four incomplete stripes that are broad above and narrow below (Fig. 2), hardly dichoptic; vertical triangle black, ocelli grey; vertex yellow with concolorous hair.

Thorax: yellow covered with concolorous hair, with four distinct black incomplete longitudinal stripes; mesopleurae and sternopleurae yellow, rest of pleurae grey, all covered with yellow hair; scutellum black anteriorly and brown posteriorly, covered with yellow hair.

Leg: yellow with concolorous hair, hind femorae slightly swollen and with incomplete black horizontal and complete black vertical band (Fig. 1), the under surface of hind tibiae toothed (Fig. 1).

Wing (Fig. 3): smoky, bare, stigma yellowish black, vein R_4+_5 distinctly looped into first posterior cell, spurious vein barely touches the anterior cross vein; anterior alulae small, posterior large, both with a fringe of silvery white hair; halteres yellow.

Abdomen: covered with yellow hair, first segment grey, second segment with black cephalad margin and with a brown spot in the middle, third and fourth segments brown and both with a yellow cephalad band.

MALE TERMINALIA

Periphallic organs: ninth tergite pubescent (Fig. 4); cerci roughly triangular, densely pubescent and bear long hair (Fig. 4); surstyli roughly triangular (Fig. 5); surstylar apodemes U-shaped.

Phallic organs: sternite round anteriorly (Fig. 6), with two process and a cup like

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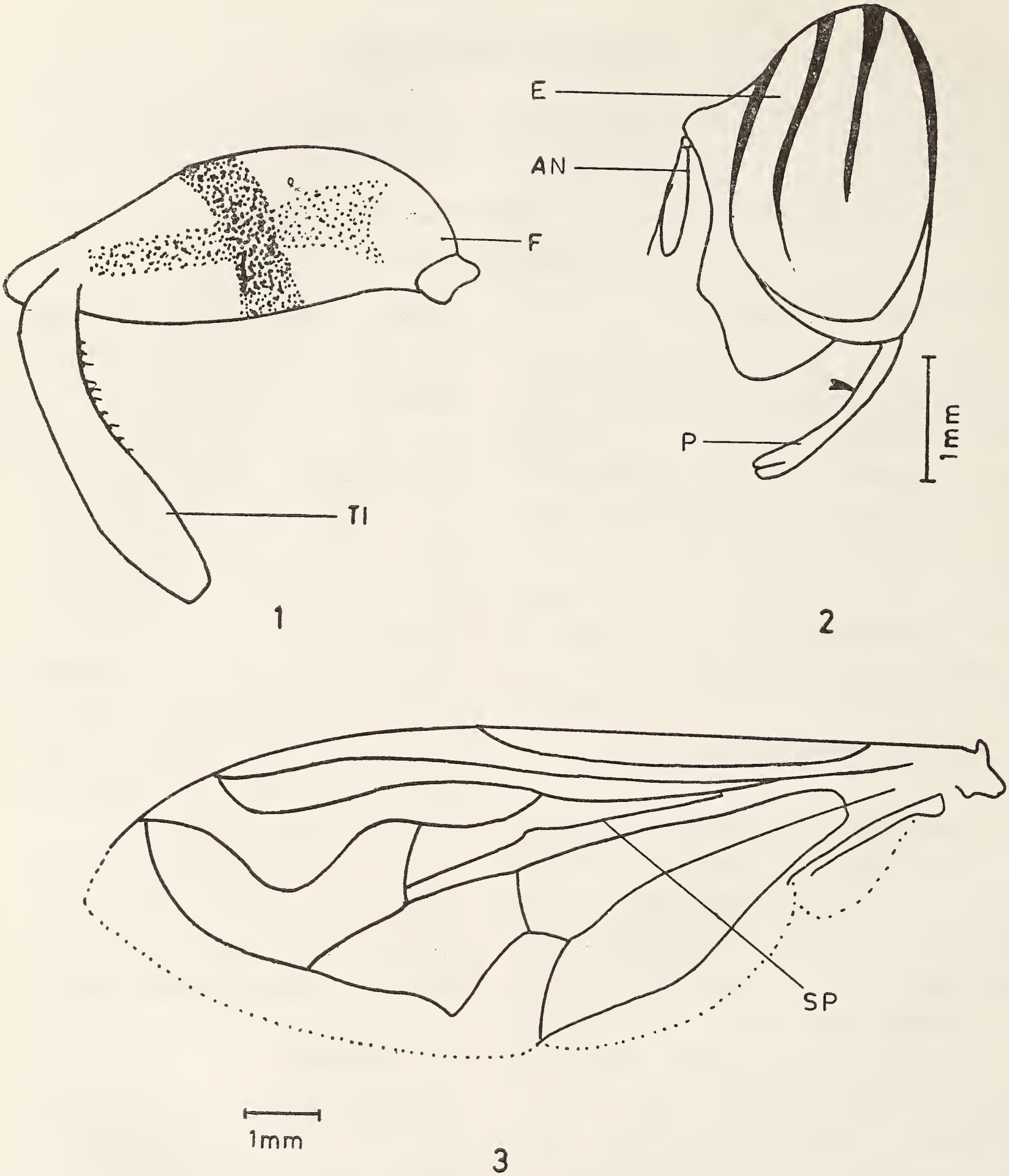
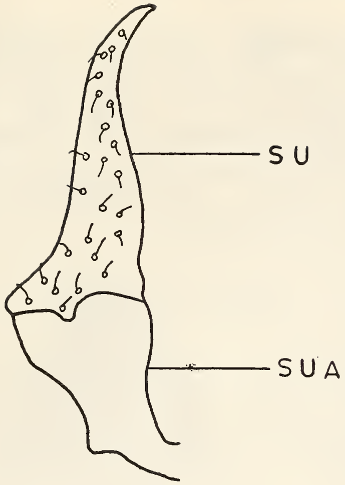


Figs. 1-3. *Eristalis yamunanagarensis* sp. nov.
1. Hind femora and tibia; 2. Head in profile; 3. Wing.
Abbreviations: AN, Antenna; E, Eye; F, Femora; P, Proboscis; SP, Spurious vein; TI, Tibia.



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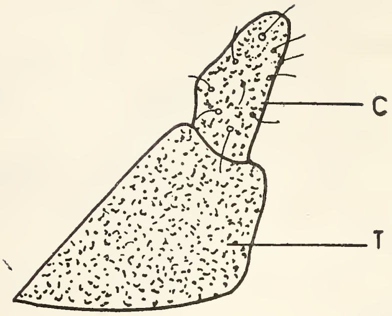

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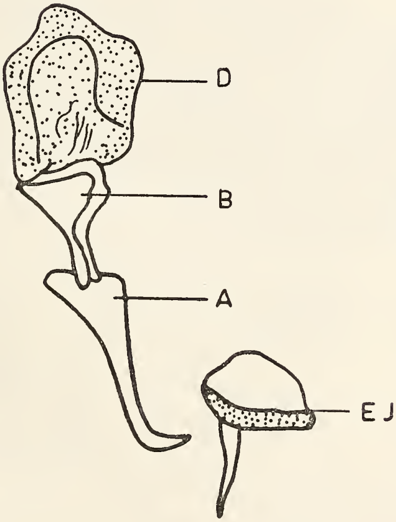

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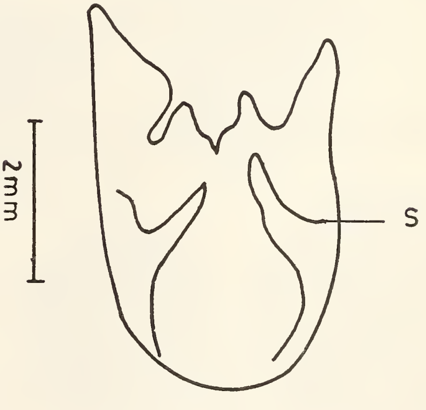

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Figs. 4-7. *Eristalis yamunanagarensis* sp. nov.
4. Cercus and part of tergite (9th); 5. Surstyle and a part of surstylar apodeme; 6. Sternite (9th); 7. Aedeagus and ejaculatory apodeme.
Abbreviations: A, Aedeagal apodeme; B, Basal aedeagus; C, Cercus; D, Distal aedeagus; EJ, Ejaculatory apodeme; S, Stermite (9th); SU, Surstyle; SUA, Surstylar apodeme; T, Tergite.

depression posteriorly; aedeagal apodeme Y-shaped (Fig. 7); basal aedeagus formed of two Y-shaped plates (Fig. 7); distal aedeagus roughly a squarish plate (Fig. 7); ejaculatory apodeme mushroom-shaped (Fig. 7).

Length of body 7.5 mm (devoid of antennae), length of wing 6.7 mm.

FEMALE: Unknown.

Holotype: Adult ♂ from Yamunanagar (Haryana) from wild vegetation, 12.xi.1983. Coll. V. Gupta.

Paratypes: 2 ♂♂, same data as holotype. Types in Entomology Section, Department of Zoology, Panjab University, Chandigarh.

Remarks: This species superficially resembles *Eristalis quinquelineatus* Fabricius, but differs from it in having no longitudinal stripes on the face; eyes having four stripes in place of six; legs yellow rather than grey and having two bands on femora.

ACKNOWLEDGEMENT

We thank the Chairman, Department of Zoology, Panjab University, Chandigarh for providing necessary research facilities.

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NEW SPECIES OF *RICCIA - RICCIA INDIRA-GANDHIENSIS* SP. NOV.[1]

G. T. DABHADE[2] AND AKHTAR HASAN[3]

(*With six text-figures*)

The genus *Riccia,* has attracted attention of bryologists on account of its controversial position in the evolution of bryophytes. A comprehensive account of it is given by Stephani (1900, 1910-1924) and Jones 1952, 1957). Indian species have been described by Kashyap (1916), Pande (1924), Chopra (1938), Ahmad (1942), Shrivastava (1964) and Ram Udar (1956, 1961, 1978). Stephani (1910) recognized 130 species whereas Reimers (1916) recognized nearly 200 species throughout the world. It is the commonest liverwort in India having about 40 species including 11 species from Western Himalaya, 12 species from Eastern Himalaya, 16 species from Central India, 11 species from South India and 5 species from Western India (Dabhade 1975, 1985).

The 5 species of *Riccia* from Western India recorded by Dabhade (1975, 1985) are *R. discolor* L. et L., *R. billarderi* Mont. et N.,

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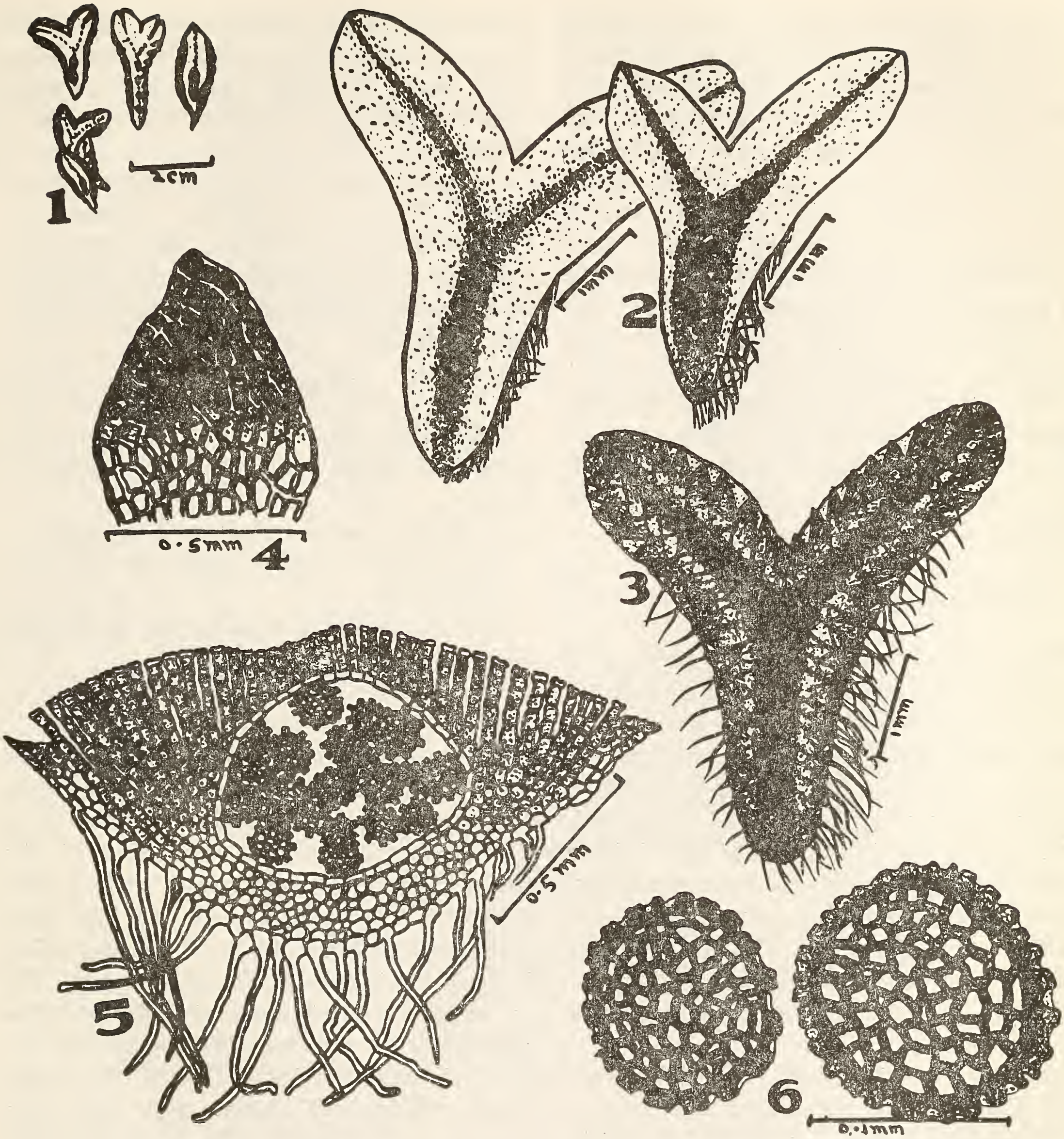

Figs. 1-6. *Riccia indira-gandhiensis* sp. nov.
Fig. 1. Very small thalli with only once dichotomous branching; Fig. 2. Enlarged view of thallus (Dorsal view) showing deep sulcus, only once dichotomous branching & sporophyte by vertical splitting; Fig. 3. Enlarged view of thallus (ventral side) showing ventral scales & smooth rhizoid; Fig. 4. Ventral scale showing hyaline structure at base and coloured at apex; Fig. 5. T. S. of thallus showing epidermis assimilations filament, rhizoides sporophyte; Fig. 6. Enlarged view of spores showing 6-8 reticulations, dentate margin of the wing.

R. plana Taylor, *R. fluitans* L., and *R. frostii* Aust. In addition to these a species of *Riccia* was found on moist, lateritic ground at Poona. From careful morphological and anatomical observations it appears that characters of this species differ from rest of the known species of *Riccia.* Important characteristic features are (1) the presence of deep sulcus upto base and single dichotomous branching, (ii) the presence of only smooth rhizoids, (iii) the presence of hyaline, thin walled subrectangular epidermis, (iv) the prominent partially coloured ventral scales, (v) the large dentate spores with 6-8 reticulation. As this species of *Riccia* differs from the known species of the genus, it is described as a new species — *Riccia indira-gandhiensis* sp. nov.

Riccia indira-gandhiensis sp. nov.

Thallus glaucescentes, 5-9 mm longus, 2-8 mm latus et 0.8-1 mm crassus. Semel dichotome ramosus. Sulcus profundus extensus ad basin. Tantum levibus rhizoideis. Squamae prominentes et ultra margine thalli extensae. Squamae fulvae ad marginem sed hyalinae basi, 230 μ longitudine. Cilia destituta sunt. Cellulae epidermales incoloratae et subrectangulares. Sporophytum unum vel duabus seriebus, pro maxime parte effectum in dimidio posteriore thalli. Soprae dentatae, 170-190 μ diametro. Reticulum 6-8 septatum, 10-12 μ longum et 5-8 μ latum.

Dioecious, small, bluish or bluish-green thalli. Thallus deeply sulcate upto the base, upto 5-9 mm long, 2-8 mm broad, 0.8-1 mm thick, only once dichotomously branched; epidermis one layered, cells sub-rectangular, thin walled, hyaline; scales large, overlapping, violet-black but hyaline at base, ± extending the margin; cilia absent; only smooth rhizoides. Spore tetrahedral, circular, brown, 170-190 μ in the diameter, reticulate lamellate with 6-8 areoles across the outer 10-12 μ face long and 5-8 μ broad wing 7-9 μ wide, brown-pinkish, margin dentate. Only female thalli found (Figs. 1-6).

Habitat:

On moist lateritic ground at Poona (Maharashtra) Coll: G. T. Dabhade. Specimen No. 103. Dabhade's collection, Dt. 20-8-1981. Duplicate material of this species is deposited in Bryological Herbarium of Lucknow University, Lucknow.

IDENTIFICATION

Stephani (1900, 1910-1924) divided the 130 species of *Riccia*, recognized by him into 2 groups :-

1. *Riccia* (compact thalli with air canal).
2. *Ricciella* (spongy thalli with large air cavities).

The first group has been further divided into 2 sub-groups :-

a — *Ciliatae* — (thalli with Cilia).
b — *Inermis* — (thalli without Cilia).

The present species collected and described by us is non-Ciliate (*Inermis*), with compact thalli and narrow air canals. It differs from *Riccia crozalsii* Levier in the absence of cilia and as it lacks the simplicity in spore margin (Udar 1957). According to the Late Prof. Ram Udar (in litt. 7th Jan. 1985), this species differs from all the known species of the genus. The new species of *Riccia* is named as *Riccia indira-gandhiensis* sp. nov. to commemorate the memory of Late Mrs. Indira Gandhi, the former Prime Minister of India, who had done dynamic work in accelerating the development of Science and Technology in India.

ACKNOWLEDGEMENTS

We are grateful to the Late Prof. Ram Udar, Professor in Botany, Lucknow University, Lucknow for guidance in the identification of this new species of *Riccia*. Our thanks are due to Dr. S. C. Srivastava, Reader in Botany, Lucknow University, Lucknow for providing literature and useful suggestions and also to Fr. C. Mascarenhas of St. Xavier College, Bombay for latin translation. We also express our grateful thanks to Prin. G. P. Srivastava of M. D. College, Bombay-400 012 for providing laboratory facilities and encouragement.

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* Original not seen.

A NEW GENUS OF ECTRICHODIINAE FROM SOUTHERN INDIA (INSECTA-HETEROPTERA-REDUVIIDAE)[1]

DUNSTON P. AMBROSE[2] AND DAVID LIVINGSTONE[3]

(*With four text-figures*)

A new genus of Ectrichodiinae *viz., Noehaematorrhophus* Gen. nov. is described and illustrated. A key for the identification of Indian Echtrichodiinae genera is formulated. The new genus is differentiated from the closely allied genus *Haematorrhophus* Stal. The holotype (Female) collected from Malumichampatti, a semiarid zone in Coimbatore district, Tamil Nadu, India is deposited in the Insect collection, Division of Entomology, Bharathiyar University, Coimbatore, India.

INTRODUCTION

In her key to the genera of Asian Echtrichodiinae, Cook (1977) has mentioned that the subfamily Echtrichodiinae is readily recognised by its characteristic two pronged scutellum and on the basis of scutellum, nature of

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rostral segments, architecture of pronotum and the extent of anteocular and postocular areas she has enumerated the key for forty one genera. Distant (1904) considered the number of antennal joints as the primary character in enumerating the keys for his eleven genera of Echtrichodinae. In the present investigation the antennae are also taken into consideration.

Members of the subfamily Echtrichodiinae alone have been described by Distant (1904) as having more than four antennomeres. On the basis, the new genus *Neohaematorrhophus* is included under the subfamily Echtrichodiinae. It has five segmented antennae with two intercalary segments in between third and fourth and fifth segments where as *Haematorrnophus* Stal (*Physorhychus* Amy. & Serv.) has been described by Distant as having six jointed antennae. Out of the twenty four species recorded in India the genus *Haematorrhophus* Stal has the maximum number (10) of species represented.

Neohaematorrhophus Gen. nov.

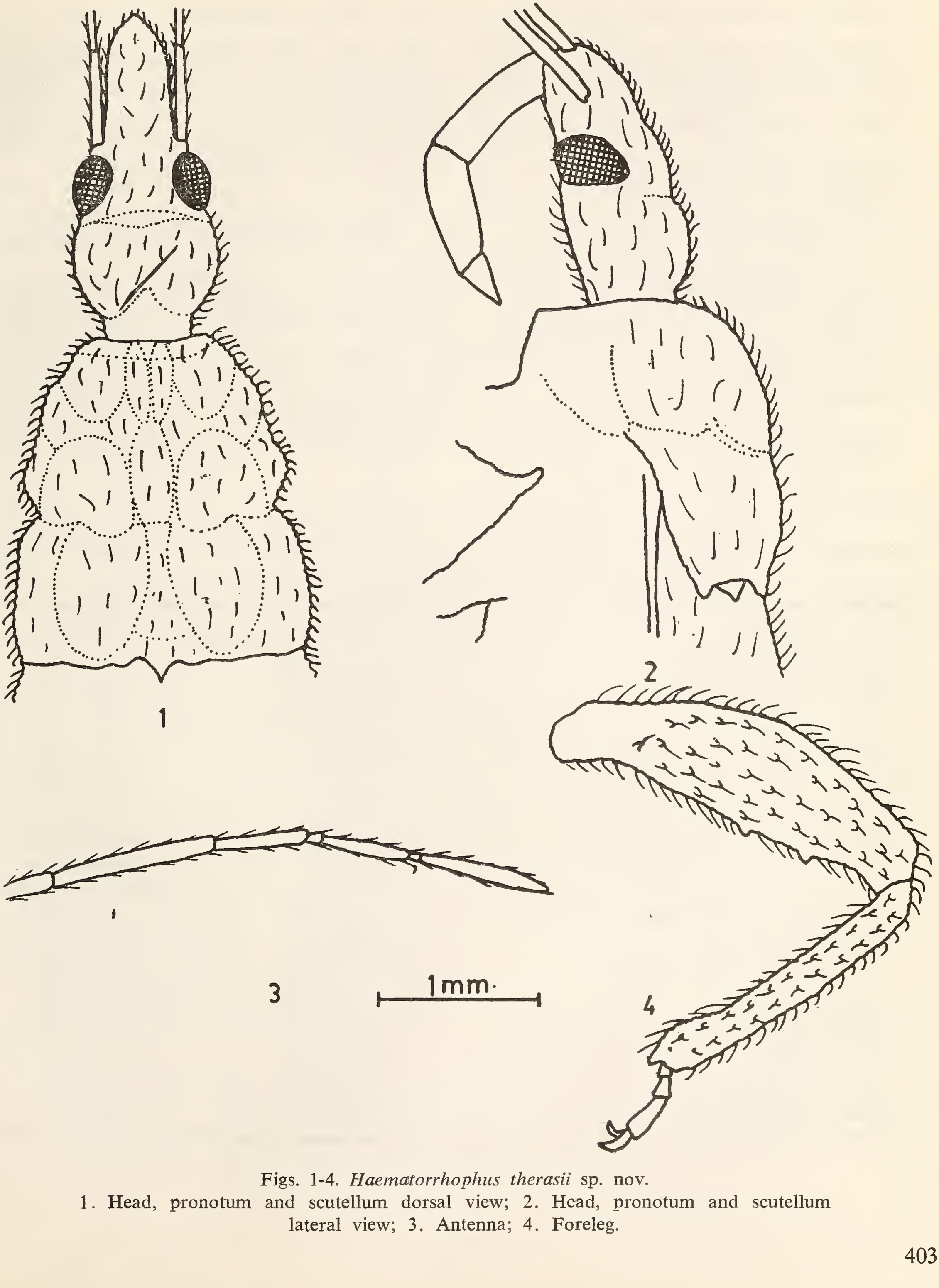
Body oblong, head elongate, anteocular area $1\frac{1}{4}$ longer than postocular area, antennae five segmented, rostrum less crescentic, the first joint not extending beyond the eyes, transverse furrow dividing the prothorax into almost equal halves, anterior lobe bulbous, bearing a median prominent foveation not extending beyond the pronotal transverse furrow, very narrow collar bearing minute lateral tubercle, the posterior lobe more rectangular, smooth, porterolaterally faintly deflected, scutellum very minute bearing a median and lateral angulations; median angulations more prominent, anterior femora somewhat strongly incrassated bearing two prominent ventral tubercles subapically and a few very minute ones along the length; fossula spongiosa not prominent, median abdominal scent gland orifice found on the fourth segment more prominent than those on the third and fifth segments. The males alate and females micropterous.

The foregoing description on the genus clearly differentiate it from *Haematorrhophus* and therefore the erection of new genus *Neohaematorrhophus* is appropriate, though it has close affinity to the former.

KEY FOR THE IDENTIFICATION OF GENERA OF ECHTRICHODIINAE

Distant (1904) considers the number of antennal joints as the primary character in formulating the synopsis for the eleven genera of the family Echtrichodiinae. But, he fails to include two genera *Antiopula* Stal and *Quercetanus* Distant since the two genera are only represented by specimens in which the antennae are imperfect. But he lists a number of characters by which both genera are easily recognized from the other eleven genera as well as from the newly described genus. The number of antennal segments is taken as the primary character in preparing this synopsis.

1. Antennae with eight joints, ... 2
   Antennae with less than eight joints 5
2. Scutellum with two apical spinous angulations 3
   Scutellum with three apical spinous angulations, the middle one minute ...... *Ectrychotes* Burm.
3. Rostrum with first joint longer than remaining joints together 4
   Rostrum with first joint about as long as remaining joints together ....*Scadra* Stal.
4. Head long, about as long as anterior femora connexivum with its margin even, not spined .... *Audernacus* Distant
   Head not prominently elongated, connexivum with basal segment spinously produced .... *Bayerus* Distant
5. Antennae with seven joints 6
   Antennae with less than seven joints 8
6. Anterior femora unarmed 7



Figs. 1-4. *Haematorrhophus therasii* sp. nov.
1. Head, pronotum and scutellum dorsal view; 2. Head, pronotum and scutellum lateral view; 3. Antenna; 4. Foreleg.

Anterior femora strongly spined near apex...... .... *Labidocoris* Mayr.
7. Antennae with first joint about as long as head; eyes not unusually prominent ..... *Mendis* Stal.
Antennae with first joint much longer than head; eyes exceedingly prominent .... *Libavius* Distant
8. Antennae with six joints 9
Antennae with less than six joints 11
9. Abdomen rugose; not globose 10
Abdomen globose, above levigate not rugose... .... *Eriximachus* Distant
10. Abdomen beneath not longitudinally impressed, or with the first four segments linearly medially impressed .... *Haematorrhophus* Stal.
Abdomen beneath with the first four segments distinctly centrally divided ...... *Stegius* Distant
11. Antennae with five segments................. .... *Neohaematorrhophus* Gen. nov.
Antennae with four segments ...... *Vilius* Stal.

AFFINITIES

The new genus *Neohaematorrhophus* has close affinity to *Haematorrhophus* in having the following characters: Body oblong, first and second rostral segments subequal in length and transversely constricted pronotum.

However the new genus can be very easily differentiated from the genus *Haematorrhophus* by the longer anteocular area, five segmented antennae, very narrow collar bearing minute lateral tubercle, anterior bulbous pronotal lobe with a median foveation not extending beyond the pronotal transverse furrow, more rectangular smooth posterior lobe with postero lateral faint deflection, very minute scutellum with a more prominent median and less prominent

TABLE 1

MEAN VALUES OF ($\bar{x}$±SE) MALE AND FEMALE MORPHOMETRIC ANALYSES OF *Neohaematorrhophus therasii* IN MM (N=6)

No.	Characters	Male	Female
1.	Length of anteocular area	1.12±0.09	1.09±0.09
2.	Length of postocular area	0.72±0.04	0.61±0.04
3.	Width between eyes	0.54±0.01	0.57±0.02
4.	Diameter of eyes	0.38±0.03	0.42±0.02
5.	Length of first antennal segment	0.25±0	0.25±0.02
6.	Length of second antennal segment	0.85±0.07	0.95±0.06
7.	Length of third antennal segment	0.46±0	0.59±0.02
8.	Length of fourth antennal segment	1 ±0	1.02±0.01
9.	Length of fifth antennal segment	1.14±0.01	1.02±0.01
10.	Length of first rostral segment	0.83±0	0.87±0.03
11.	Length of second rostral segment	0.86±0.05	0.83±0.02
12.	Length of third rostral segment	0.32±0.03	0.34±0.02
13.	Length of prothorax	1.03±0.1	1.24±0.12
14.	Width of prothorax	1.67±0.11	1.77±0.18
15.	Length of fore tibia	1.77±0.04	1.85±0.07
16.	Length of mid tibia	1.58±0.03	1.56±0.02
17.	Length of hind tibia	2.58±0.28	2.21±0.04
18.	Length of wing	4.99±0.32	1.12±0.11
19.	Width of wing	2.4 ±0.3	0.53±0.05
20.	Length of abdomen	3.71±0.51	3.69±0.13
21.	Width of abdomen	2.65±0.16	3.16±0.17

lateral angulations, strongly incrassated anterior femora with two prominent ventral, subapical tubercles and a very few minute ones along the length, spongy furrow not prominent, median abdominal scent gland orifice in the fourth segment more prominent than those on third and fourth segments.

Neohamatorrhophus therasii sp. nov.

Holotype Female, Reg. No. 7, Insect collection, Division of Entomology, Bharathiyar University, Coimbatore, India.

Paratypes were collected (11.6.1978) from Malumichampatti semiarid zone in Coimbatore district and Maruthvazhmalai scrub jungle in Kanyakumari District by Dunston P. Ambrose (Ambrose 1980).

Length 7 mm, width across pterothorax 4 mm. Violaceous black except the dark maroon colour of the terminal two flagellar segments.

Head richly pilose, moderately large, a median transverse impression just behind the eyes delimiting a much longer acutely pointing anteocular area from a shorter globous postocular area that posteriorly narrowing into the neck; Ocelli maroon coloured just behind the transverse impression and the inner margin of eyes; filamentous antennae five segmented, scape short not extending beyond the clypeal limit, pedicel long and terminal flagellar segment longer than first and second flagellar segment individually which measure in equal length; slender three segmented almost straight (semi crescentic) rostrum reaching the prosternal stridulatory furrow while at rest, first two segments subequal, the first joint not extending beyond eyes, the third segment very short.

Prothorax richly pilose, marginally with pale fine hairs, each originating from marginally serrated angulations, transverse impression delimiting an anterior and posterior pronotal lobes which subequal in length, the anterior lobe more bulbous, smooth with a median longitudinal moderately shallow foveation not extending beyond its posterior limit and very indistinct lateral longitudinal elevations not reaching the ends anteriorly, delimiting a very narrow collar having very small nodule like lateral tubercle; posterior pronotal lobe less bulbous but rectangular, smooth, posterolateral angles slightly deflected in the form of flange; scutellum very tiny, not spinous but broadly angular, median angulation more prominent; legs relatively shorter, midleg the shortest and hind leg the longest, tibial spongy furrow less prominent, serrated and richly pilose, anterior femora strongly armed ventrally with two prominent tubercles and a few minute tubercles along the longitudinal ridge; micropterous, wing rudiments not reaching abdomen (males alate). (Figs. 1-4).

Abdomen richly pilose, but margins not serrated, a large maroon spot marking the second abdominal scent gland orifice at the dorsum of fourth abdominal segment, prominent orifice of the scent glands of the lateral margins of first abdominal segment slit like, abdomen slightly longer than broad.

Sexual dimorphism is well pronounced. Longer and broader prothorax, longer forelegs, shorter hind legs, micropterous condition of wings and broader abdomen are the diagnostic features of females. Morphometric analyses of both sexes are given in Table 1.

The species is named after Mother Theresa.

ACKNOWLEDGEMENTS

We are grateful to the authorities of University of Madras Post Graduate Centre, Coimbatore for facilities. One of us (DPA) is grateful to CSIR, New Delhi for financial assistance during the course of this investigation.

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A NEW SPECIES OF *LACTUCA* (ASTERACEAE) FROM KASHMIR, INDIA[1]

S. K. MAMGAIN AND R. R. RAO[2]

(*With four text-figures*)

Lactuca kashmiriana sp. nov., a new species allied to *L. decipiens* Clarke is described.

During the course of a revision of the subtribe *Lactuceae* in India, we examined some specimens which showed affinities to *Lactuca decipiens* Clarke in general habit of plant but on critical examination of specimens both at BSD and DD, proved that the specimens were of a new species, which is described here.

Lactuca kashmiriana sp. nov.

L. decipienti Clarke affinis, sed differt bracteis involucralibus exterioribus perbrevioribus, bracteis involucralibus interioribus ad centrum fuscatis cum marginibus hyalinis; acheniis gradatim angustatis ad rostrum longum cum costis regularibus manifestis in doubus lateribus.

Herba perennis. Caulis ca 60-80 cm altus, erectus, glaber, sursum paniculatim ramosus. Folia ca 4-5 × 3-5 cm., numerosa e basi ad medium caulis, cum foliis minoribus ad axillas foliorum latiorum, folia inferiora et supramediana cum petiolis longis alatisque, membranacea, cordata vel deltoidea, varie dentata, sagittata vel auriculata, suprema acute serrata, ovata vel hastata. Inflorescentia paniculatim ramosa. Capitula ca 13-14 x 1-2.5 mm in ramis terminalibus, cernuis, angustis, cylindricis, 2-3 floris, pedunculus parvus, gracilis, glaber, nutans, flosculus ligulatus, ligula purpurea vel azurea. Bracteae involucrales exteriores ca 1-1.5 x 0.5-1 mm, ovatae, bracteae involcurales interiores 5, aequales, ca 13-14 x 2-2.5 mm, lineari-lanceolati, perangustati, glabri vel setosi, cum centro fuscato, marginibus hyalinis, quam bracteis exterioribus perlongiores. Achenia ca 6-6.5 mm longa, oblanceolata, gradatim angustata ad rostrum longum; costae regulares, manifesti, cum costa mediana conspicua in uno latere, 11-12 costata in altere latere, angustata ad uterque extremitates quam centro, glabra, pallide luteo brunnea. Pappus ca 4-5 mm, pallide albida.

Holotypus lectus: INDIA: Kashmir: Degwan *B. M. Wadhwa* 67012A et positus in CAL.

Lactuca kashmiriana sp. nov.

Allied to *Lactuca decipiens* Clarke, but

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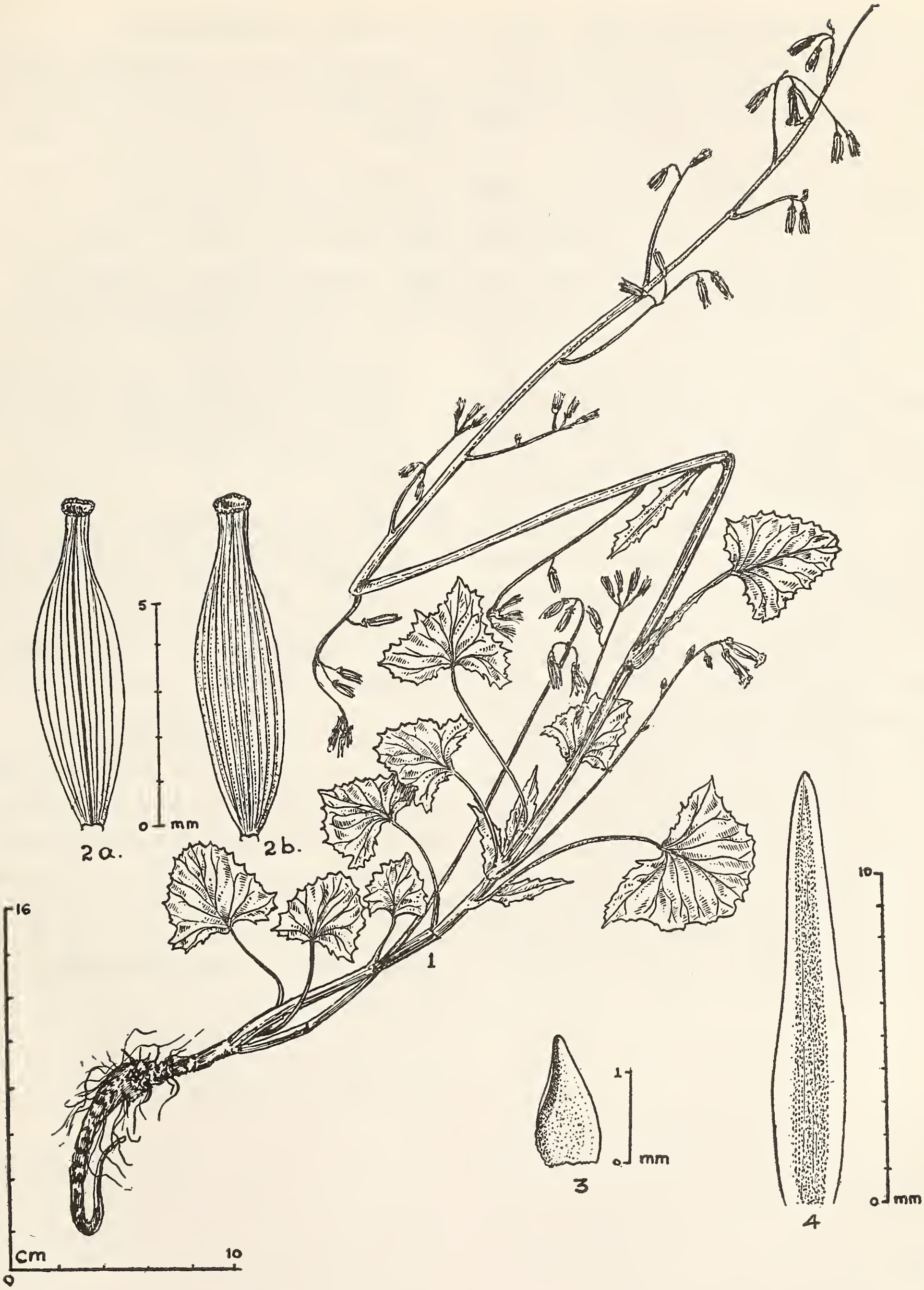
[1] Accepted January 1986.

[2] Botanical Survey of India, Dehra Dun, (U.P.).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2a.
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16
cm
0
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4

Figs. 1-4. *Lactuca kashmiriana* sp. nov.
1. Habit; 2. (a) Achene (ventral side); 2. (b) Achene (dorsal side); 3. Outer involucral bracts; 4. Inner involucral bracts.

differs in having much smaller outer involucral bracts, inner involucral bracts dark in the centre with hyaline margins; achenes gradually narrowed to a long beak with distinct and regular ribs on both sides.

Perennial herbs. stem *c.* 60-80 cm high, erect, glabrous paniculately branched above. Leaves *c.* 4-5 x 3-5 cm many from base to middle of the stem mixed with number of smaller leaves at the axils of broader leaves, lower and upper middle leaves with long and winged petiole, membranous, cordate or deltoid, variously toothed, sagittate or auricled, upper most sharply serrate, ovate or hastate. Inflorescence paniculately branched. Heads *c.* 13-14 × 1-2.5 mm, on terminal branches drooping, narrow, cylindric, 2-3 flowered, peduncle small, slender, glabrous, nodding, florets all ligulate, ligule purple or blue. Outer involucral bracts *c.* 1-1.5 x 0.5-1 mm ovate, inner involucral bracts 5, equal *c.* 13-14 x 2-2.5 mm linear lanceolate, much narrowed glabrous or bristly hairy with darker centre and hyalined margins, much longer than the outer bracts. Achenes *c.* 6-6.5 mm long oblanceolate gradually narrowed to a long beak, ribs regular, distinct with a conspicuous mid rib on one side, 11-12 ribbed on other side, narrowed at both ends from the middle, glabrous, pale yellowish brown slightly larger than the pappus *c.* 4-5 mm pale whitish.

Fls. & Frts.: September.

Specimen studied: Holotype: India, Kashmir: Degwan *B. M. Wadhwa* 67012A (CAL); Isotype *B. M. Wadhwa* 67012B (BSD).

Remarks: Erect perennial herbs, florets purple or blue. This species is very distinct from all other species of *Lactuca* but shows slight resemblances to *L. decipiens* Clarke; however it can be separated as follows.

A. Outer involucral bracts *c.* 4-6.5 x 1.5-2.5 mm unequal half of the length of the inner bracts, inner involural bracts much broad bristly hairy uniform in colour. Achene abruptly narrowed into small beak more or less glabrous or very sparsely hairy, ribs not very distinct. Blackish Brown. .... *Lactuca decipiens*

B. Outer involucral bracts *c.* 1-1.5 x 0.5-1 mm all equal much smaller than the inner one; inner involural bracts very narrow glabrous or sparsely bristly hairy with dark centre and hyaline margins. Achenes gradually narrowed in to a long beak, glabrous, ribs distinct regular, yellowish brown. .... *Lactuca kashmiriana*

ACKNOWLEDGEMENTS

We are grateful to the Director, Botanical Survey of India, Howrah for facilities and to Dr. N. C. Majumdar, Regional Botanist, Botanical Survey of India, Dehra Dun for Latin translation. The Senior author is also grateful to Director, Botanical Survey of India, Howrah for providing a research fellowship.

TETRASTICHUS DAVIDI SP. NOV. (HYMENOPTERA: EULOPHIDAE) A PRIMARY PARASITOID ASSOCIATED WITH *EARIAS VITTELLA* (FABRICIUS) (LEPIDOPTERA: NOCTUIDAE) FROM INDIA[1]

M. A. Khan[2], D. Arul Samraj[3] and Nikhat Khan[4]

(*With ten text-figures*)

The eulophid parasite *Tetrastichus davidi* sp. nov. is described from the material collected from the pupae of *Earias vittella* on cotton during January, 1985 from Padappai Tamil Nadu, India.

Tetrastichus davidi* sp. nov.
(Figs. 1-10)

FEMALE

Head: (Fig. 1) Dark blackish brown, reticulate sculpture, setose, wider than long in frontal aspect (0.64 mm: 0.51 mm), width of frons between eyes less than half of head width, fronto-vertex wide; ocelli arranged in obtuse angle triangle, eyes setose; subocular suture absent; mandible (Fig. 2) tridentate with sharp apices, maxillary and labial palpi one segmented each.

Antenna: (Fig. 3) Dark brown except scape white and pedicel on greater part light brown; densely setose on flagellum; scape cylindrical, more than four times longer than wide (0.26 mm: 0.06 mm); pedicel long, more than twice as long as wide (0.11 mm: 0.05 mm), shorter than first funicle segment, funicle with a ring segment, first funicle segment elongated, less than twice longer than wide (0.13 mm: 0.04 mm), second funicle segment a trifle longer than wide (0.08 mm: 0.07 mm), third funicle segment greatly transverse, much wider than long (0.075 mm: 0.06 mm), club three segmented, longer than preceding two funicle segments combined.

Thorax: Dark blackish brown with bluish reflections, setose with fine reticulate sculpture, scutum wider than long, three pair of adnotauler bristles; scutellum shorter than scutum with fine longitudinal reticulations with two pair of long, strong setae; surface of propodaeum shagreened, both median and lateral carinae present, propodael spiracle not quite contiguous with anterior margin.

Fore wing: (Fig. 4) Hyaline, more than twice as long as wide; submarginal vein with three long, strong setae, costal cell broad with thirteen setae arranged in a row; marginal vein very long; stigmal vein (Fig. 5) less than $\frac{1}{4}$ as long as marginal vein; post marginal vein very short.

Hind wing: Hyaline, almost five times as long as wide.

Fore leg: (Fig. 6) Yellowish except coxae and femora dark brown, densely setose, apex of coxa with three long, strong setae, apical rim of tibiae with a fine row of bristles, six in number arranged in a row, with three stout prominent pegs; tibial spur very short; part of the fore leg as shown in Fig. 6.

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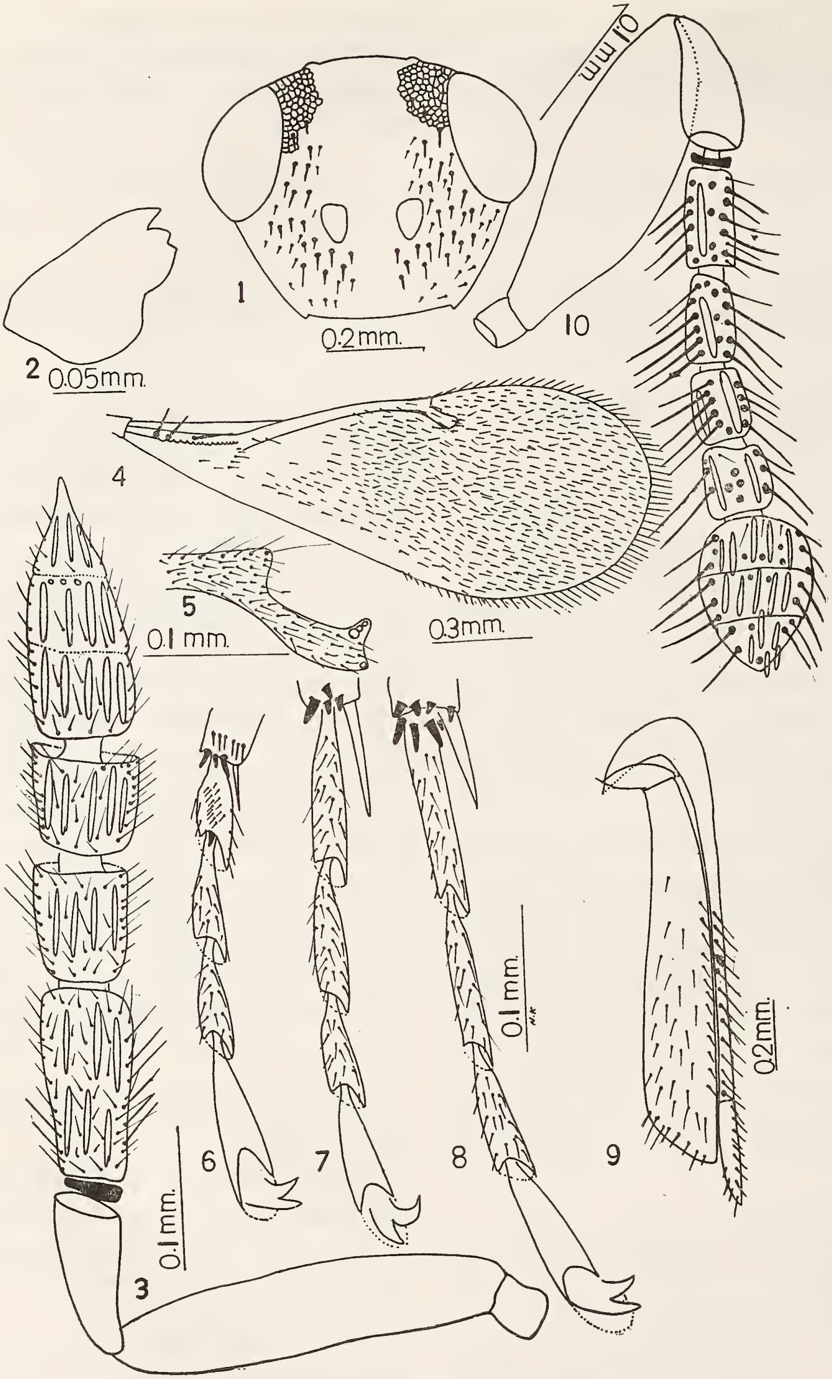
* This species is named after Dr. B. V. David, Director, FIPPAT, Padappai-601 301, India.


1
0.2mm.
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6
7
8
0.1 mm.
9
0.2mm.
3
0.1 mm.

Figs. 1-10. *Tetrastichus davidi* sp. nov.
1. Head, Frontal aspect, ♀; 2. Mandible, ♀; 3. Antenna, ♀; 4. Forewing, ♀; 5. Part of forewing Venation, ♀; 6. Part of Foreleg, ♀; 7. Part of middle leg, ♀; 8. Part of hind leg, ♀; 9. Ovipositor; 10. Antenna, ♂.

Middle leg: (Fig. 7) Uniformly yellowish except coxae at basal dorsal margin infuscated, uniformly densely sectose; apex of coxae with a long bristle; apical rim of tibiae with four short, stout pegs, tibial spur shorter than basitarsus; part of the middle leg as shown in Fig. 7.

Hind leg: (Fig. 8) Uniformly yellowish except coxae at basal end infuscated, apex of coxa with four long bristles, apical rim of tibiae with eight stout pegs; tibial spur short; part of the hind leg as shown in Fig. 8.

Abdomen: Brown with yellowish bands, longer than thorax, uniformly setose, female genitalia as shown in fig, ovipositor slightly exserted.

Length of female: 1.75 mm (size varies from 1.35 mm to 1.80 mm in a series of specimen studied).

MALE

Resembles female except in the following characters.

Antenna: (Fig. 10) Uniformly yellowish except club dark brown or black, very densely setose; scape dialated, three times longer than wide; pedicel long, more than twice longer than wide, distinctly much longer than first funicle segment, funicle four segmented with a transverse ring, funicle segments elongated, decreasing in size distad except fourth funicle segment transverse; club three segmented, very stout, almost one and a half times longer than wide, longer than preceding two funicle segments combined.

Leg: Uniformly yellowish except fore coxae at basal half infuscated.

Length of male: 1.21 mm.

Material examined:

Holotype: Padappai, Tamil Nadu, India, 26-2-1985 reared from pupae of *Earias vittella* on cotton (D. Arul Samraj). Hym. Eulo. Nr. 1021.

Paratype: 8 ♀♀, 2 ♂♂ same data as holotype. Hym. Eulo. Nr. 1022 (D. A. Samraj). Material is being deposited in Z.S.I. Calcutta, India.

REMARKS

This species is remarkably different from all the known Indian species and comes closer to *Tetrastichus varicornis* (Girault) Burks, 1943 from which it can be distinguished by the following key characters.

1. Body black, part of scape, antennal club, middle and hind trochanters, bases and apices of femora and tibiae and basal segments of middle and hind tarsi white, antennal pedicel one eight longer than first funicle segment, club globose, as long as second and third funicle segments combined, submarginal vein of forewing with five dorsal bristles. .... *T. varicornis* (Girault) Burks

— Body dark blackish brown except abdomen with yellowish bands; Scape white; legs uniformly yellowish except fore coxae and femora completely brown, mid and hind coxae only infuscated at basal margins; pedicel shorter than first funicle segment, club with tapering at apex in female, in male it is globose (as shown in Fig. 10), distinctly longer than second and third funicle segments combined; submarginal vein of forewing with three dorsal bristles .... *T. davidi* sp. nov.

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1. A PICTORIAL GUIDE TO THE BIRDS OF THE INDIAN SUB-CONTINENT. By Sálim Ali & S. Dillon Ripley. Pp. 117+106 plates (73 in colour, 33 monochrome), (18.5 cm × 24.7 cm) with plates by John Henry Dick. New Delhi, 1983. Bombay Natural History Society & Oxford University Press. Rs. 120.00 (Now Rs. 155.00).

Inspite of the availability of several monographic books on birds of the Indian Subcontinent dating back to 1862 (Jerdon's *Birds of India*), through two editions of the *Fauna of British India, Birds* (Oates and Blanford's 1889-1898, and Baker's 1922-1930) to the recently published *Handbook of the birds of India and Pakistan* (Ali and Ripley 1968-1974), and several regional books and field-guides, no illustrated work depicting all or most species of birds of the region had been published until the book under review came out in 1983 to fill the lacuna. This is a remarkable book for it illustrates almost all the species of birds of the Subcontinent in a single, not-too-unwieldly volume. The publishers are to be congratulated for bringing out this eminently useful book during the Bombay Natural History Society's centenary year.

A map of India and adjacent countries, depicting the area covered by the book is printed on the front endpapers, as also a glossary of terms used in referring to the habitats of birds. The text proper starts with a brief introduction, followed by an elaborate systematic index of families and the species included under each. In this chapter every family and larger subfamilies have been defined. Each species or subspecies covered bears a number equivalent to that used in the authors' *Handbook* or Ripley's *A synopsis of the birds of India and Pakistan* (1982). Although the sequence of families and species follow these two works, the plates and illustrations of species do not always correspond. The rest of the book consists of plates, 73 in colour and 33 monochrome, and their explanation on facing pages.

The illustrations are generally well done, but too bold to show feather detail; nevertheless quite pleasing to the eye. Monochrome illustrations depicting various birds in flight are very useful indeed, so are the tails of the various snipes.

I have however a few comments to make, chiefly to point out certain omissions and to supplement the data contained in the book.

In the front flap of the jacket it is claimed that *all* species of birds found in the Subcontinent are illustrated, but at least ten such species do not find any place in the book. They are the Redbreasted Merganser, Eastern Little Stint, Saunders's Little Tern, Rothschild's Parakeet, Himalayan Cuckoo, Andaman Brown Hawk-Owl, Hume's Short-toed Lark, Eastern Great Reed Warbler, Bluntwinged Paddyfield Warbler, and Blyth's Pipit.

Front endpaper map of India and adjacent countries. It is not quite understood why Bhutan, an independent country, should be coloured (yellow) like the states of India (e.g. Meghalaya or Orissa) while other such countries are left white. Nor is it clear why Pakistan is bordered with blue but Nepal, Bangladesh and Sri Lanka with red.

Front fly-leaf. *Duars.* Prior to 1841 Bhutan had a wide duars belt extending from the Tista River in the west to the country's eastern border. The eastern two-third (approx.) of that area was annexed to British India in 1841 and merged with Assam, and the remaining western part which was ceded by Bhutan to British India in 1866, was merged with Bengal. Since 1866, therefore, Bhutan has no 'duars'. 'Bhutan duars', as sometimes used in zoological literature, obviously refers to the old duars area that once belonged to Bhutan, but is now located partly in West Bengal and partly in Assam, India.

Pages 3 and 4 (left cols.) Ali and Ripley's HANDBOOK should be dated 1968-74.

Page 95, explanation of fig. 5. Nepal should be included in the range.

Plate 45, facing page 114. The figures do not show the birds 'From below' as stated.

Page 120, explanation of fig. 8. The bird does occur in Pakistan 'from Kohat eastwards in the foothills' (Ripley, 1982, *Synopsis,* p. 168).

Page 127. The Brownwinged Kingfisher is depicted in fig. 12 (*not* 9) and the Storkbilled Kingfisher in fig. 9 (*not* 12) of plate 58.

Page 139, explanation of fig. 14. Range should be from Murree to Sikkim (intergrading with *macella* in East Nepal and Sikkim).

Page 143, explanation of figs. 18 and 19. The distribution of *Pomatorhinus horsfieldii schisticeps* (fig. 18) should be what is given under fig. 19; the zoological name of the bird depicted in fig. 19 should better be given as *Pomatorhinus horsfieldii* ssp., and its distribution as Peninsular India.

Page 159. There is no explanation for fig. 16.

Page 161. The Slaty Blue Flycatcher is shown in fig. 18 (*not* 17), and its eastern subspecies *minuta* in fig. 17 (*not* 18) of plate 92.

Page 165. Greyheaded Myna is depicted in fig. 4 (*not* 3) and the Whiteheaded subspecies *blythi* in fig. 3 (*not* 4) of plate 96.

Page 169, explanation of fig. 3. The species occurs east of Ladakh to eastern Himalayas.

Some of the illustrations are not quite well-executed, hence misleading. For instance:

Plate 16, fig. 1, Scavenger Vulture. Head should be naked.

Plate 33, figs. 1 & 2, Common and Burmese Peafowls. There should be red on train-tips.

Plate 91, fig. 5, Allied Flycatcher-Warbler. The crown should be striped grey and black, and there should be one (*not* two) wing-bar.

Plate 91, fig. 9, Greycheeked Flycatcher-Warbler. Black coronal band not shown. Chin should be grey. There should be one (*not* two) wing-bar.

Plate 91, fig. 12, Greyheaded Tailor Bird. The supercilium should be shorter and yellow (*not* white) in colour.

Plate 91, fig. 13, Chestnutheaded Flycatcher-Warbler. The nape should be grey (*not* yellow) and the lower breast and abdomen bright yellow (*not* white).

Plate 94, fig. 12, Grey Shrike. The black frontal band is not shown.

Plate 94, fig. 13, Redbacked Shrike. The figure marked '♀' does not appear to be an adult bird.

Plate 98, fig. 6, Legge's Flowerpecker. The terminal white spots on rectrices are not shown.

Plate 98, fig. 9, Red Munia ♀. The white spots on upper tail-coverts are not shown.

Plate 98, fig. 16, Rufousbellied Munia. The spots on the rump should be white, *not* black.

Plate 100, fig. 5, Altai Accentor. The centre of abdomen should be white, without streaks.

Plate 102, fig. 6. Large Rosefinch ♂. The forehead should be pink, and there should be no streaks on the rump.

Plate 102, fig. 9, Threebanded Rosefinch ♂. The back should be streaked with grey.

Plate 102, fig. 10. Whitebrowed Rosefinch ♀. There should be only one wing-bar.

Plate 102, fig. 12, Eastern Great Rosefinch ♂. The back should be streaked, and the outer rectrices edged white.

Plate 104, fig. 9, Black-and-Yellow Grosbeak ♂. There should be no red patch on the collar.

Plate 104, fig. 10, Allied Grosbeak ♀. The rump should be yellowish olive-green, the same as on the collar.

Plate 104, fig. 14, Crested Bunting ♂. The tail is disproportionately short.

Colour reproductions in many cases could be better. In general, ashy and grey are with a blue cast, chestnut too deep, frequently black is dark brown, crimson is seldom crimson, and various shades of red are not distinguishable. Particularly unpleasant are :

Plate 94, fig. 10, Burmese Shrike. The tips of two central pairs of rectrices should be rufous, *not* white.

Plate 95, fig. 16, Yellow Wagtail. The supercilium should be white, and the head bluish grey.

Plate 96, fig. 6, Daurian Myna. The chin and throat should have a rufous tinge, and the tail edged on the outer side with buff.

Plate 100, fig. 11, Pere David's Snow Finch. The forehead and lores should be black.

Plate 102, fig. 17, Crossbill ♂. The general body-colour should be orange-red.

Plate 103, fig. 7, Ortolan Bunting. There should be no grey or blue-grey in the plumage.

Plate 103, fig. 9, Little Bunting. The supercilium should be rufous.

I do not know if these discrepancies are due to the artist or the printer.

These minor shortcomings do not weaken the tremendous usefulness of the 'Pictorial guide' for both the serious ornithologist and the amateur bird-watcher working on birds of the Indian Subcontinent and should be a constant and valuable guide.

I am indebted to my erstwhile colleague at the Zoological Survey of India, Mr. Srikumar Chattopadhyay, for drawing my attention to some of the items listed above.

BISWAMOY BISWAS

2. INTRODUCTION TO PRINCIPLES OF PLANT TAXONOMY. By V. V. Sivarajan. pp. xi+295 (21 × 13 cm), with some text-figures. New Delhi, Bombay and Calcutta, 1984. Oxford and I.B.H. Publishing Co. Price Rs. 15.50.

The first seven chapters of the text are of general topics pertaining to plant taxonomy. I feel that these topics are not only of interest to Botany students, but also of interest to people of all categories. These chapters will really enable people to inculcate interest in the field of Taxonomy. The author has really done a marvellous job in collecting enough data to add to these chapters, in the most simple and interesting manner. Since few educational institutions have literature on Taxonomy, it becomes really difficult for the students to collect such literature, a problem solved by the book, which will be easily accessible to students, staff and to other categories of people who are interested in the subject.

One of the striking points about the book is the inclusion of "Plant Nomenclature" as a chapter in the text. Plant nomenclature is the most important and essential factor which every student in Plant Taxonomy should know. But in most cases, I feel, students neglect this important aspect. They try to copy from literature which is available, without understanding the principles. This is due to the unavailability of books on nomenclature and the difficulty to understand the rules and regulations of the International Code of Botanical Nomenclature. In the text, the author has wisely included this most important and essential chapter, for which I personally feel happy. The author has tried his best to present the rules and regulations of the code in the most simple and easily understood manner. However, I feel that it would have been better if a few examples had been cited where the nomenclature is wrong, and then point out step by step (citing the appropriate rules of the code) how to correct such errors.

The reference and index at the end of the book also is of great advantage to the reader.

On the whole the book is a welcome addition to taxonomic literature. The book will be of much use to students of Botany. The price of the book also is quite nominal and students should feel happy and proud to have such a book for their personal use.

S. M. ALMEIDA

3. TEMPLES OR TOMBS? Industry versus environment: Three controversies. by Darryl D'Monte. pp. xv + 285 (21.5 × 14 cm), with some black and white photographs. Centre for Science and Environment. New Delhi, 1985. Price hard cover Rs. 125/-.

The author has examined three issues which have been the subject of public controversy in recent years. The Silent Valley Power generation project, the Mathura refinery with its possible threat to the Taj and the Thal Vaishet fertilizer project in Maharashtra.

In the earlier chapters he has discussed the concept of development, and has shown, with quotations from various authorities, that the growth process and the GNP are no longer considered as reliable indicators of development. As the Pakistan economist Mahbub ul Haque has stated, for the third world development should be concerned not merely with "how much is produced but with what is produced and how it is distributed". The green revolution with bumper production of food grains, because of the increasing cost of inputs in fertilizer, irrigation, power, etc has also increased prices. Thus it has only marginally helped the common man who cannot afford to increase his consumption of food grains even when freely available at the prevailing enhanced prices. Further as 'development', industry and agriculture continue to encroach on forest and wilderness, they also reduce the means of subsistence for the farm labourer or the tribal, who now has to buy from a trader, the resources they traditionally obtained free from forest and jungle. Our efforts to protect the remaining forest lands, and to introduce 'social' forestry (where the trees are to be preserved upto a particular period and then sold for specific purposes like paper making), further estrange the tribal from his natural habitat and lead to clashes and disturbances when the tribal protests.

We are aware of these facts now, but there is a lag between awareness of the facts, and of reflecting this awareness in our development plans. Our plans for development of industry power etc. are still based on the conventional economic criteria which do not take account of environmental resources used and destroyed, in the process. The payment of a lumpsum compensation to a displaced tribal or villager has very little effect on his future. Efforts at rehabilitation so far have been half hearted or ill advised and the displaced persons merely add to the rootless, homeless multitude who are classified, even by official reckoning, as below subsistance level.

In analysing the three controversies covered by the book, the author has made a careful study of all available information and published reports on each. He has also spoken to individuals who had interested themselves in these matters and has placed all the facts before the readers, then presented a dispassionate overview of the situation.

It would not be possible in a short review to summarize the evidence which the author has collected from diverse sources, with a great deal of effort, thought and perseverance. Understanding of the facts and of the processes and the motivations behind the various proposals put forward are of great interest to all persons interested in conservation. From the author's record of events in each case we gain some insight into the decision making process. An insight which is very necessary if we wish to make any contribution to influence the final outcome.

In all these cases, the author states the decision was a political one, and was not based on any scientific reasoning. Unfortunately, in any democratic set up, decisions of this nature are always political, in the sense that they will go in favour of whoever wields the most political clout. It is only when organisations like the Sierra Club in America have attracted a large enough membership to carry some political clout by weight of numbers that they are able to influence decisions. This is a fact of life we must accept, and we must work at building up informed public opinion which can exert political pressure when needed. In Kerala the Kerala Sastra Sahitya Parishat (KSSP) undertook this role, and did succeed in arousing public consciousness of the true issue involved. It is unlikely that their support was strong enough to have political influence and it appears unlikely that the Silent Valley power generation project could have been stopped without Mrs. Gandhi's personal interest in conservation.

The other important point the author makes is to show how disorganised the tacties of the conservationists have been. Some are concerned only with a particular aspect, and ignore other factors. Some groups take such an extreme stand that they tend to oppose everything which disturbs the status quo. Those who try and take a balanced view are frequently hampered by lack of hard evidence, and often do not have access to the information available, with the result that they are unable to materially influence the decision making process.

Mr. D'monte also brings out the fact that in all three instances concerned in the book the alternatives have not been seriously considered. The decision making appears to be addressed to the question of "Is this a worthwhile venture?" Whereas what we should address is the question of "what is this venture intended to do or achieve, and what are other possible ways of achieving the same result?" If such a question had been asked at the time of planning the Thal fertilizer project, we might have considered and examined a number of alternatives. For instance, one correspondent has suggested that at a far lower cost, it would have been possible to put up biogas plants in every village, which would produce organic fertilizer of high quality for each community. We know that use of village biogas plants is fraught with social and economic problems, and this may not be a practical answer. But the point is that the feasibility of such an approach, and the possibility of tackling the socio economic problems which arise has never been examined. In each case there are alternative strategies which need to be explored and investigated. Even if an alternative is not financially cheaper, it may work out much cheaper in its impact on the environment and on our renewable resources.

It is essential therefore, that if the mistakes of the past are not to be repeated, we must seek to ask the right questions and explore the possibilities before making a decision. It is not enough to say that we need fertilizer so we must put up a factory. Is there any way in which we can provide fertilizer to the small farmer (who is the ultimate user if we wish to increase out food production), at a price within his reach, with minimal expense on distribution, subsidies etc? If we ask such questions we may come up with better answers, and may be able to better safeguard our environment and our rapidly depleting natural resources.

Mr. D'Monte is to be congratulated on bringing together, in one book, a comprehensive and dispassionate assessment of the differing arguments and points of view influencing the decision in these three cases, a study of which is an essential prerequisite for all persons who wish to understand and to influence the course of events in the interests of the country as a whole.

A. N. D. NANAVATI

4. A REVISED HANDBOOK TO THE FLORA OF CEYLON. Vol. V. Edited by M. D. Dassanayaka and F. R. Fosberg. pp. x + 476 (24.5 × 16 cm), with many Illustrations. New Delhi, 1985. Amerind Publishing Co. Pvt. Ltd. Price not mentioned.

This volume contains of revisions of six families: 1. Annonaceae by H. Huber, 2. Balsaminaceae by C. Grey-Wilson, 3. Bixaceae & 4. Cochlospermaceae by M. D. Dassanayake, 5. Cyperaceae by T. Koyama and 6. Rutaceae by B. C. Stone.

As mentioned in the earlier reviews on volumes of this series, families are handled by experts in their respective taxonomic fields and inspite of different styles of presentation by different authors very high quality taxonomic standard is maintained in the revisions.

The editors have given full authority to the contributors regarding the presentation of the material and therefore may not have checked manuscripts once they were ready for publication. A number of, probably typographical, errors have remained uncorrected in the text. For example, various years of publication has been given for a single publication as follows:

Impatiens houstoniana Arn. Comp. Bot. Mag.
1: 322, 1836 (see p. 87)
Impatiens elongata Arn. „ „ „
1: 324, 1838 (see p. 89)
Impatiens subcordata Arn. „ „ „
1: 323, 1835 (see p. 102)
Impatiens glandulifera Arn. „ „ „
1: 322, 1835 (see p. 114)
Impatiens walkerae Hook. „ „ „
1: 324, 1835 (see p. 116).
also:

Roxburgh, Pl. Corom. 1:31, t. 34, 1815 (see p. 41)
Roxburgh, Pl. Corom. 1:31, t. 35, 1795 (see p. 44).

Some of the contributors seem to be quite unaware of distribution of some of the species as well as geographical limitations of the areas.

1. About distribution of *Annona muricata* L., *A. reticulata* L. and *A. cherimolia* L. it is mentioned that they are grown for fruits but probably not naturalized in Sri Lanka.
2. Under distribution of *Hydrocera troflora*, Bengal and Madras have both been mentioned as places in south India. (see p. 80).
3. *Impatiens acaulis* is stated to be rather rare in India. (see p. 83).

These uncertain statements have originated as a result of insufficient local help.

Fuirena capitata (Burm. f.) T. Koyama and *Pycreus strmeneus* (Nees) Clarke are based on later homonyms and should be rejected in their presently accepted concepts.

M. R. ALMEIDA

5. A WORLD DIRECTORY OF ETHNOBOTANISTS. By S. K. Jain, Paul Minnis and N. C. Shah. pp. 1-52 (21 × 13 cm). Lucknow, 1986. Society of Ethnobotanists. Price Rs. 15.00 or US $2.00 or £1.50.

The purpose of this directory, according to its authors, is to establish better communication between ethnobotanists of the world.

The directory lists nearly 500 ethnobotanists from all over the globe, out of which major contributors are from India (239) and U.S.A. (147). Members from other countries are from W. Germany (9), France, Canada, Netherlands (7 each), Mexico, Australia, Great Britain (6 each), Czechoslavakia (4), Ghana, Poland (3 each), Indonesia, Nepal, Israel, Hungary, South Africa (2 each), Equador, Argentina, USSR, Tanzania, Switzerland, Greece, Spain, Peru, Denmark and Japan (one each).

There is a lack of consistency in recording the names of the countries and the various abbreviations used may lead to avoidable confusion, e.g. for just two countries W. Germany and E. Germany five different abbreviations (FRG, BDR, FDR, & DDR) have been used.

Scientists listed in the directory are from various disciplines such as Plant taxonomy, Medico-botany, Phytogeography, Cytogenetics, Tribal culture, Paleobotany, Pharmacognosy, Pharmacology, Plant breeding, Mycology, Physiology, Plant-pathology, Economic botany, Anthropology, Medico-chemistry, Bryology, Agronomy, Ayurvedic practicie, Conservation, Horticulture, Unani practice, and Mythology.

Recently the Society of Ethnobotanists (India) had organised a work-shop in ethnobotanical training programme in Lucknow. This directory contains names of participants in that work-shop in addition to the list of Paul Minnis (1976) and probably members of the society itself.

This is only a good beginning in the first step to bring together people of common interest. Let us hope that we can look forward to more seminars, work-shops etc to attract more people to join the Ethnobotany Society.

M. R. ALMEIDA

MISCELLANEOUS NOTES

1. A NOTE ON HANUMAN LANGUR, *PRESBYTIS ENTELLUS* SWIMMING

Incidents of swimming are uncommon for langurs. If an animal accidentally falls into water, it may swim a few meters in the process as was once recorded of a langur (*Presbytis geei*) swimming (Obousseier and Maydell 1954). Hanuman langur, *Presbytis entellus* to cross even narrow canals uses bridges rather than swimming across (Krishnan 1972). In Jodhpur when I was observing a troop of a male band on August 7, 1983 at 0900 hrs, a male juvenile (18 months old) accidentally fell into a pond when playing on a *Prosophis juliflora* tree. After hearing the sound, the near males (18 individuals) of the male band started looking towards the water and the juvenile. The juvenile started swimming atonce and only two thirds of the head was visible above the surface. The juvenile swam about 60 metres in 7 minutes to reach the other bank. A moment later two male juveniles of the same age approached the swimmer and smelled its head and embraced it for few seconds. Later all the three juveniles joined the other males.

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December 3, 1985.

G. AGORAMOORTHY

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2. NOTES ON THE STRANGE BEHAVIOUR OF A SNOW LEOPARD (*PANTHERA UNCIA*)

On 22nd January 1984, at 08 20 hours in the morning, I was monitoring the daily activity pattern of a Himalayan tahr herd (48 animals) in the Langu valley (3460 m) of western Nepal. When I searched the higher slopes for more animals, I saw an adult snow leopard descending towards the feeding herd on the mixed scrub slope. Except a few standing animals all individuals were feeding and moving up the slope. Almost the whole ground was covered by at least 8 inches deep snow which had fallen the previous night. When the snow leopard was about 30 m above the herd, it started stalking with the belly touching the ground and tail waving. As, the tahr were moving upwards the snow leopard and tahr were only 16 m away from each other within 10 minutes. At 08 32 the snow leopard stood up and I thought that the snow leopard was getting ready to make a rush towards its prey. I am quite positive that some of the tahr must have seen the snow leopard at that time but none seemed either frightened or gave a warning call. Once again the snow leopard started stalking when the tahr were in a very vulnerable position due to the short distance and snow on the ground. But, again the snow leopard left stalking got up and moved away from the scene. The Snow leopard went back along the same path on the snow covered slope it had used when it had appeared a few minutes earlier. It disappeared after about 300 m on the snow, high up in the mountain ridge.

I monitored the daily activity of the tahr herd till dark on that day, but the snow leopard did not return to hunt again. The tahr had followed the same daily routine as if nothing had happened to them. I have never seen the snow leopard the only predator for Himalayan tahr and blue sheep in the Langu valley, behave in such a manner before. I have witnessed several instances of snow leopard's hunting in the same area, and they had killed the ungulates in some cases and in other cases had unsuccessfully chased the animals after stalking. Perhaps the snow leopard was not hungry at that time? Or, probably it had seen me though I was about 700 m away and observing from behind a rock. What could be the possible reason?

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February 22, 1986.

3. HOW DOES THE YOUNG *TAPHOZOUS KACHENSIS* SETTLE UPON ITS MOTHER

(*With a photograph*)

In a paper published in this journal, and concerning the breeding habits of the bat *Taphozous kachensis*, Sapkal and Deshmukh (1985) said: "The young ones are not carried by the mothers on their backs as was mentioned by Brosset (1962) but are carried at the breast". The citation is not correct; I wrote: "The young keeps itself on the back of the mother" which has, in my mind, a different meaning.

Since my 1962 paper, I saw several species of bats keeping their young on their back. Kulzer had published an excellent photograph showing of this in the african molossid *Mops condylura* (see in Brosset 1966). My observations on *T. kachensis* are old (1959-1961), and I consulted my field notes in order to verify the basis of my assertion. It was recorded that lactating females were caught with half and full grown young ones on their back at Ellora, Ajanta, Aurangabad and Badami. More, I found several pictures which prove that my observations were correct. These pictures show clearly young astride the back of their mother. Some of these pictures have been published, including one, taken at Ellora, in the paper to which Sapkal and Deshmukh refered (Brosset 1962). Another one, taken at Badami accompanies the present paper.

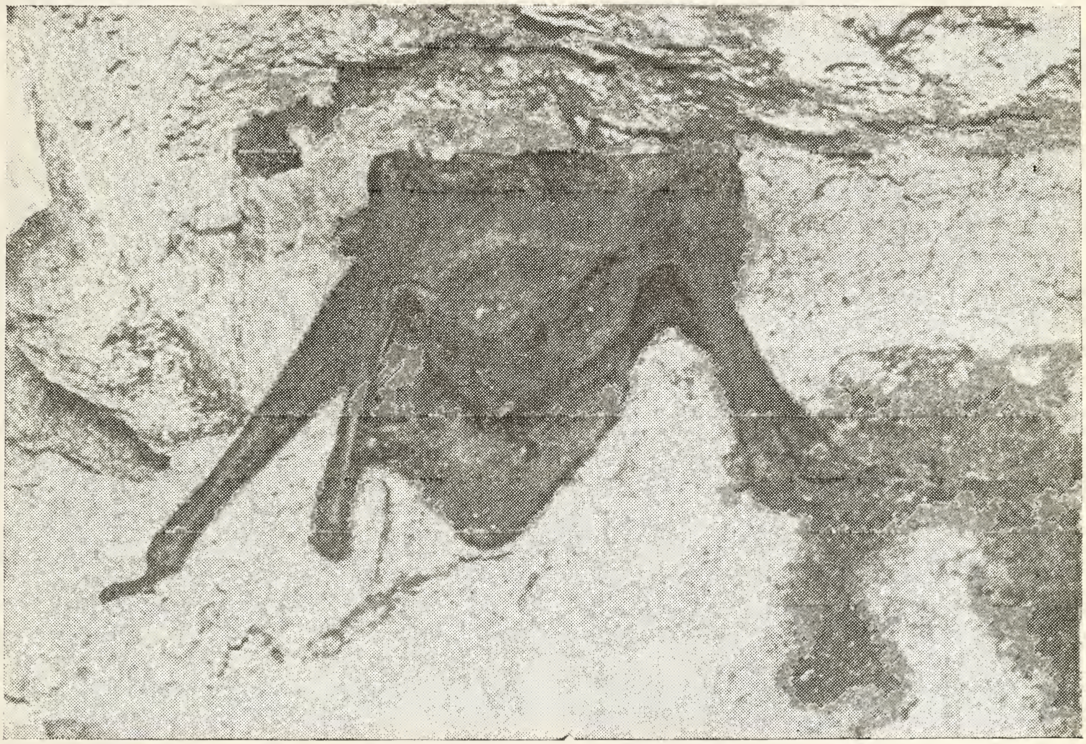

Photo 1. Lactating ♀ of *T. kachensis* with an almost fully grown young on her back.

It is a known fact that in bats, the position of the young upon the mother is variable, according to the anatomy of the species, and the type of the specific roost. The free hanging species, as the Pteropids and the Rhinolophids, keep and carry their young under the breast and belly, the Rhinolophids in an inverted position which gives both a good balance at rest and during the flight. The species which keep the belly in close contact with the walls of the roost, as the Emballonurids and Molossids do, all have a flat body and the teats in an axilliary position. Thus, the young are carried laterally under the wing; the mother is quickly destabilised by the fast growing young; and is left behind during the hunting flight, and at rest must adopt a more convenient position.

Naturally, during suckling, and probably when the mother moves, the newly born young is fastened to the teat, a fact which would explain the assertions of Sapkal and Deshmukh. But later, at rest, the fast growing young of some species, as *T. kachensis,* keeps itself on the back of the mother.

In other respects, the histological study of Sapkal and Deshmukh on the breeding habits of *T. kachensis* confirms my field notes taken in various places of North, Central and South India (Brosset 1961 and 1962): monoestrous species, mating in early April and giving birth to one young during the first half of July.

A. BROSSET

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April 16, 1986.

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SAPKAL, V. M. & DESHMUKH, A. H. (1985): Breeding habits and associated phenomena in some Indian Bats, Part X, *Taphozous kachensis* (Dobson) — Emballunoridae. *J. Bombay nat. Hist. Soc. 82*(1): 61-67.

4. PRESENT STATUS OF THE EUROPEAN COMMENSAL BLACK RAT, *RATTUS RATTUS RATTUS* (LINN.) IN BOMBAY

During the rodent blood sample collection at Rat Destruction Establishment, B.M.C., Haffkine Institute, Bombay, it was observed that the collection included jet black silky soft furred rats, which were identified with the help of Ellerman (1961), as *Rattus rattus rattus* (Linn.) (Type species). This species is a commensal rodent form from Europe. Ellerman (1961) reported the collection of two specimens belonging to *R. r. rattus* (Linn.) from Bombay and concluded that being exotic species, the specimens might have come accidentally with sea cargo. However, our examination of the present day rodent collection from Greater Bombay, revealed the fact that this species was being trapped almost everyday from the port areas of Bombay city. The average everyday collection of this rat can roughly be calculated at 1%-2% of the total rodent collection from Greater Bombay.

Rattus rattus rattus (Linn.) thus, like its counterpart, *Rattus norvegicus* (Berken.), has been trying to establish itself in Bombay for sometime. However, it seems, the black rat, could not fully establish itself in the city. The reason may be that the Norway rat is more ferocious and can adjust to the change in habits and habitat. The present record also shows the collection of *R. norvegicus* (Berken.) from the distant suburbs of Greater Bombay indicating that this rat is, now, extending its distribution in the suburban areas as well.

Careful observations also showed the collection of both the sexes in different age groups varying from juvenile to adult (including pregnant) of *R. r. rattus* (Linn.), Thus the European black rat is not just an accidental visitor at this stage as Ellerman (1961) concluded then, but it has gained a footing in the new home and is trying to establish itself in the city. Similar survey of this rat from other port cities of India may throw some light on its possible chances of survival in the changed habitat.

We are thankful; to the Director, Zoological Survey of India, Calcutta, for permitting us to publish this note; to the Officer-in-charge, Z.S.I., W.R.S., Pune; to the Insecticide Officer, Bombay Municipal Corporation, Bombay and also to Dr. D. M. Rainapurkar, Asstt. Director, Zoonosis, Haffkine Institute, Bombay, for providing the facilities for the present work.

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5. THE BIOLOGY OF COLLARED PIKA, *OCHOTONA RUFESCENS*, WITH REFERENCE TO ORCHARDS OF BALUCHISTAN (PAKISTAN)

METHODS AND MATERIALS

41 individuals were kill trapped (size 17.5 × 9.5 cm) from orchards of Ziarat and Choatair (altitudes above 2300 m, sharing characteristic *Juniperus macropoda* forests) valleys during May and July, 1984. Each individual was weighed and sexed. Females were checked for plugged vagina, and uteri examined for pregnancy status. The number and weight of the embryo and number of the uterine scars was recorded. The activity of ovaries was judged on the basis of their visibility. The population levels were judged through trap success.

RESULTS AND DISCUSSION

Table 1 presents the trap success exhibited by the different samples. The overall trap suc-

TABLE 1

TRAP SUCCESS IN DIFFERENT SEXES IN THE SAMPLE OF *Ochotona rufescens* COLLECTED FROM ZIARAT AND CHOATAIR DURING SPRING AND SUMMER

Locality	Spring			Summer			Total		
	Total	Male	Female	Total	Male	Female	Total	Male	Female
Ziarat	5.00	3.61	1.39	3.06	2.78	0.28	4.14	3.28	0.86
Chaotair	6.47	4.04	2.43	1.25	1.25	0.00	3.64	2.73	0.91
Total	5.10	3.53	1.57	2.87	2.67	0.21	3.98	3.11	0.87

cess is higher in the spring sample (May, 5.10) than the summer (July, 2.87). This can be explained on the basis of a higher activity level exhibited by the species during May as compared with July. Our results largely agree with Roberts (1977) suggesting that in Baluchistan this species is more industrious during March/April, when growth of the new vegetation is at maximum, and becomes rather less active during June/July. The higher trap success exhibited by the May-sample from Choatair (6.47) as compared with that from Ziarat (5.00) can be explained on the same basis, Choatair being located at higher altitude is expected to have a late ensueing of spring. The overall trap success is, however, higher in Ziarat (4.14) than in Choatair (3.64), suggesting that the general population level of the species is higher at Ziarat. The trap success regarding overall sample of the two localities may yield some direct constant for the general population level, different interacting factors producing a uniform vulnerability to trapping.

The data on the distribution of males and females in the samples collected from the two localities and in two seasons as well as in the overall sample (Table 2) indicates a relative preponderance of the males. The non significant heterogeneity sex chi square suggests that all the samples are essentially similar. This may be explained on the basis that either males are more active/more attracted towards some novel items (traps) or conversely females have a limited home range.

All the nine females trapped weighed more than 180 g, generally placed in the older adult class, while the lower weight classes were represented by males only. In fact 1:1 sex ratio was maintained in the older adult class, suggesting that females of older class are as active as males.

The presence of visible ovaries in all females support the previous observations that the species is reproductively active during summer months (Roberts 1977). The presence of reproductively active females in our May-sample suggest that the reproductive activity in the area may extend upto May and two clear cut reproductive episodes, as previously suggested may not be very faithfully adhered to. There may be considerable longer reproductive

TABLE 2

Distribution of males and females in the sample of *Ochotona rufescens* collected from Ziarat and Choatair during spring and summer. Chi square (appearing in parenthesis) has been calculated after application of Yate's correction of continuity

Locality	Spring			Summer			Total		
	Male	Female	Sex Ratio	Male	Female	Sex Ratio	Male	Female	Sex Ratio
Ziarat	13	5	2.60:1 (2.722)	10	1	10.0:1 (5.818)	23	6	3.83:1 (8.828)
Chaotair	5	3	1.67:1 (0.125)	4	0	4.0:1 (2.250)	9	3	3.00:1 (2.083)
Total	18	8	2.25:1 (2.722)	14	1	14.0:1 (6.857)	32	9	3.56:1 (2.805)

period, mainly determined by the availability of favourable vegetation.

The number of embryos recorded from two females averaging around 7 largely go in conformity with Roberts (loc. cit.), suggestion that the species is a rather prolific breeder in the area.

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ACKNOWLEDGEMENTS

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AFSAR MIAN

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6. A NOTE ON 'EAR-SORE' IN SARISKA WILDLIFE SANCTUARY, RAJASTHAN

(*With a photograph*)

Ear-sore has been reported from nilgai in Gir, Gujarat by Hiregoudar (1974); and is frequently reported from cattle, domestic buffalo and elephant in many parts of India, (Hiregoudar and Chatupale 1965, Hiregoudar 1974). Casual observation of nilgai in Sariska Wildlife Sanctuary, Alwar, Rajasthan in 1984 (March, May, November) and again in 1985 (July and November), showed a high proportion of animals with such a condition. As previous notes did not comment on the prevalence of the infection in wild populations, the opportunity is now taken to do so.

Ear-sore was readily observable in the stationary animal, as black and red scabs and sores on the inner proximal part of the ear pinna. Three degrees of infection were distinguished:

a) Light infection: No apparent loss of ear tissue, the pinna margins still rounded and smooth. Minor scabs and darkening of skin, some exudate and thickening of pinnae.

b) Medium Infection: Outer edge of pinna is torn and ragged, considerable thickening of tissue, large scabs and sores, black and red exudate.

c) Severe infection: As above but with considerable loss of tissue, on occasion up of half the pinna had been destroyed.

Photograph shows a male nilgai with an obvious severe infection.

TABLE 1

INCIDENCE OF EAR-SORE AMONGST NILGAI IN SARISKA W.L.S. 1984

Category	No. examined	No. infected	Early	Medium	Severe
Male adult	21	16	4	7	5
Female adult	26	18	6	9	3
Subadult	22	11	11	0	0
Total	69	45	21	16	8
Percentage		65%	30%	23%	12%

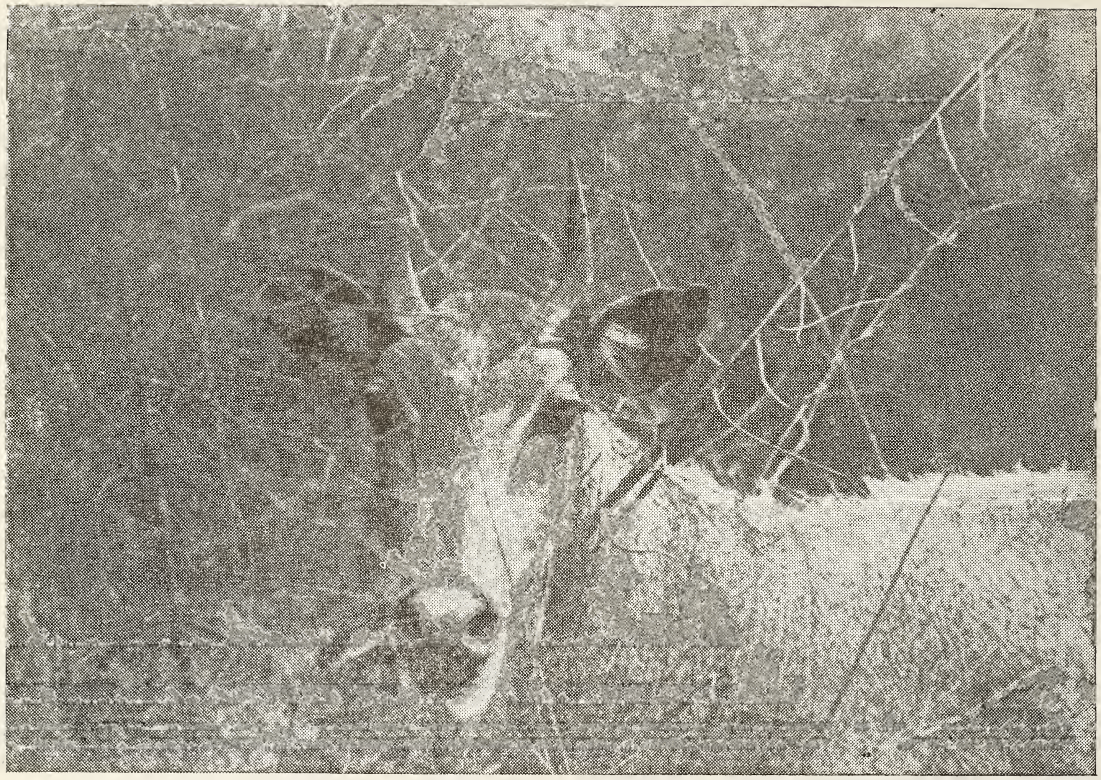

Photo 1. Male Nilgai with obvious severe infection.

Infection was noticed amongst adults and subadults of both sexes. No infection was seen in calves or yearlings. Table 1 illustrates the level of infection in the population in May and August 1984. No infection was seen in spotted deer or sambar in Sariska. Cattle populations in and around the sanctuary apparently do not suffer from this infection.

Ear-sore or Stephanofilarial dermatitis in nilgai is a result of infection by a filarial nematode *Stephanofilaria assamensis* Pande 1936, which causes the active lesions and tissue granulation (L. S. Hiregoudar, pers. comm. 1984). In no case did infected nilgai display overt signs of irritation. Birds were not seen to peck at sores, but flies were common on the sores. The vector of this filaria is not known but is probably a biting fly.

Adult female nilgai in Sariska are in noticeably poor condition (visible ribs and pelvic girdles) compared to males, or to female nilgai elsewhere, e.g. Ranthambore. No correlation between ear-sore and condition was noticed; prime condition adult males often had severe infections.

No sign of ear-sore was seen on nilgai in Ranthambore National Park in November 1985, nor in close examination of tranquilised animals from an enclosure in Bhatinda, Punjab (Franzmann, pers. comm. 1985). It has been suggested that the Sariska infection may have originated from migrating cattle, which used to move from Gujarat through Sariska to the Jamuna Valley (Fateh Singh, pers. comm. 1985). Such movements are no longer permitted.

What should or could wildlife managers do about such infections? The answer is almost certainly 'nothing'. Treatment amongst cattle is difficult. Eradication from a wild ungulate population would be impossible without the unacceptable policy of culling infected animals. Animal condition and reproductive parameters do not seem to be affected. Managers should, however, monitor incidence of infection, and body condition amongst wild animals and domestic cattle given grazing rights in wildlife areas. If infection rates markedly increase and body condition and reproductive performance are seen to decrease as a result, then management action may become necessary.

There is no hard evidence to link this earsore infection, or the 1968 outbreak of haemorrhagic septicaemia in Sariska sambar to past migratory cattle. However such poor condition cattle populations almost certainly do act as reservoirs of pathogens, and their passage through major wildlife areas should be prevented.

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7. A SCANNING ELECTRON MICROSCOPE STUDY OF THE HAIR KERATINS OF SOME ANIMALS OF THE INDIAN SUBCONTINENT — A PRELIMINARY REPORT

(*With fifteen figures in eight plates*)

This study examines the surface structure and cross sections of the hair keratins of some animals with the Scanning Electron Microsope (SEM). The conventional technique of embedding hair in suitable media and studying their structure with the ordinary optical microscope often results in optical artifacts especially with unstained specimens. These can be avoided with the SEM. The hair keratins show significant differences particularly in cross section and we feel that the use of the SEM can provide valuable additional data.

INTRODUCTION

The determination of the structure of hair is of great interest since it affords a method of identification of the particular animal from which it has originated. It is one of the reliable methods adopted for establishing predator prey relationships by systematically identifying the prey from the hairs in the faeces of the predator (Schaller 1969). The usual method employed for structure determination is to mount the hair in a suitable medium (Koppikar and Sabnis 1976) or make a replica of it (Korschgen 1981) and view the slide in an optical microscope. The relative thicknesses of the cortex and medulla and their refractive indices at different points on the same hair are such that optical artifacts can easily arise, especially since the samples are viewed without staining them.

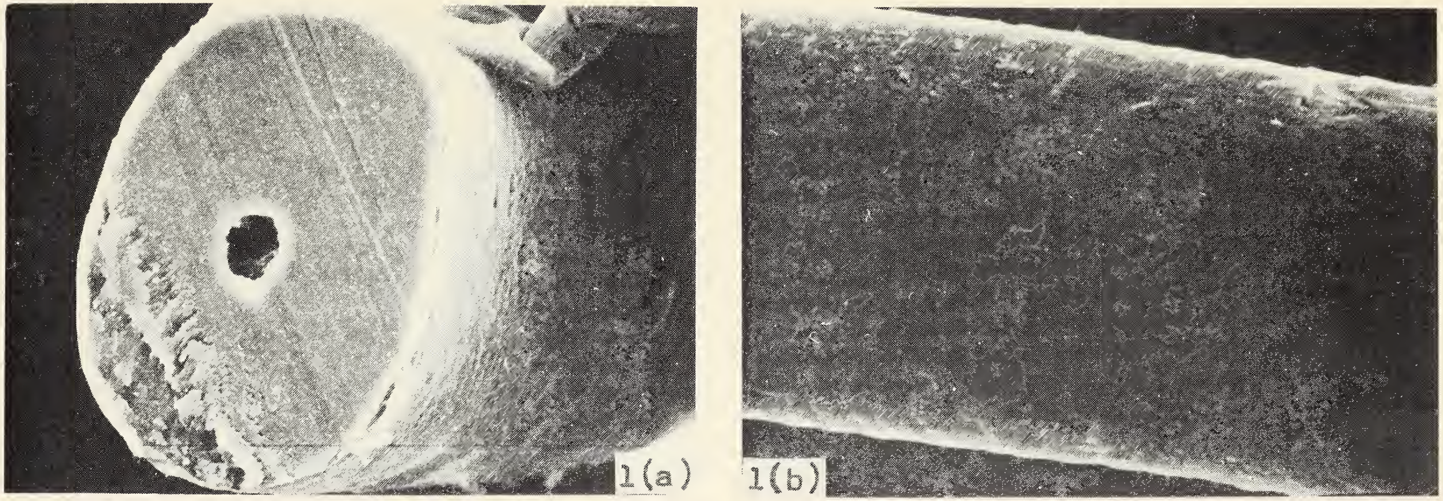
For instance, if the refractive index at any region is the same as the surrounding medium, the region will not be differentiated. Depending on the thickness and the refractive index, the medial regions may show some pattern resulting from the passage of light through the cortex and medulla. The surface scale pattern *per se* is seen only at the edges and at the tip of the hair where the material is sufficiently thin. The use of the SEM can overcome these inherent defects in observations with the optical microscope since it gives an image of the surface alone. The SEM also gives higher resolution, vastly improved depth of focus and continuous magnification up to 10,000 or more. In this preliminary study, the surface structure and cross sections of hair keratins from some animals of the Indian subcontinent are studied.

Materials and Methods

Hair samples have been obtained from the rump portion of adult males unless otherwise mentioned. The samples were cleaned in isopropyl alcohol in an ultrasonic bath for three minutes to remove surface dirt. Those samples whose cross sections were to be studied were stuck to cellophane paper and the cross sections were exposed by cutting with a new blade. These were mounted on to aluminium stubs with conducting silver paint. The samples were coated with gold in a sputter coater to a few angstroms thickness to make the surfaces conducting for observation in a Cambridge Stereoscan S 150 SEM.

Results and Discussion

Figures 1 to 15 depict the cross sections and surface features of the various hair keratins studied. The differences between the various species is very evident especially in the cross sections. All hair keratins have the free ends of their cuticular scales sloping towards the tip or distal end of the hair. In the porcupine quill however, the scales point towards the root (Fig. 5b). This is functionally very significant. The quill is a weapon of defence and it penetrates skin and muscle. Since the scales point away from the sharp tip, they do not hinder the penetration and once the quill has pierced the tissue, the scales would resist the withdrawal of the quill. The cross section of the quill shows that it is also tubular (Fig. 5a) with a spongy medulla surrounded by a solid cortex which affords high strength in compression in the functional state when the quills are driven into the body of the predator. There are many notable differences in the structure of other keratins as well. A medulla is absent for some hairs like the Lion-tailed macaque (Fig. 1a), the buffalo (Fig. 7a), the hog hair bristle (Fig. 14a) and in human hair (Fig. 15a). All these have a small pore at the centre with the bear (Fig. 4a) having a rudimentary medulla. Cow hairs (Fig. 6a, b) show regions where the medulla may be present or absent. The presence of a solid cortex affords stiffness to the hair. Thus hog hair



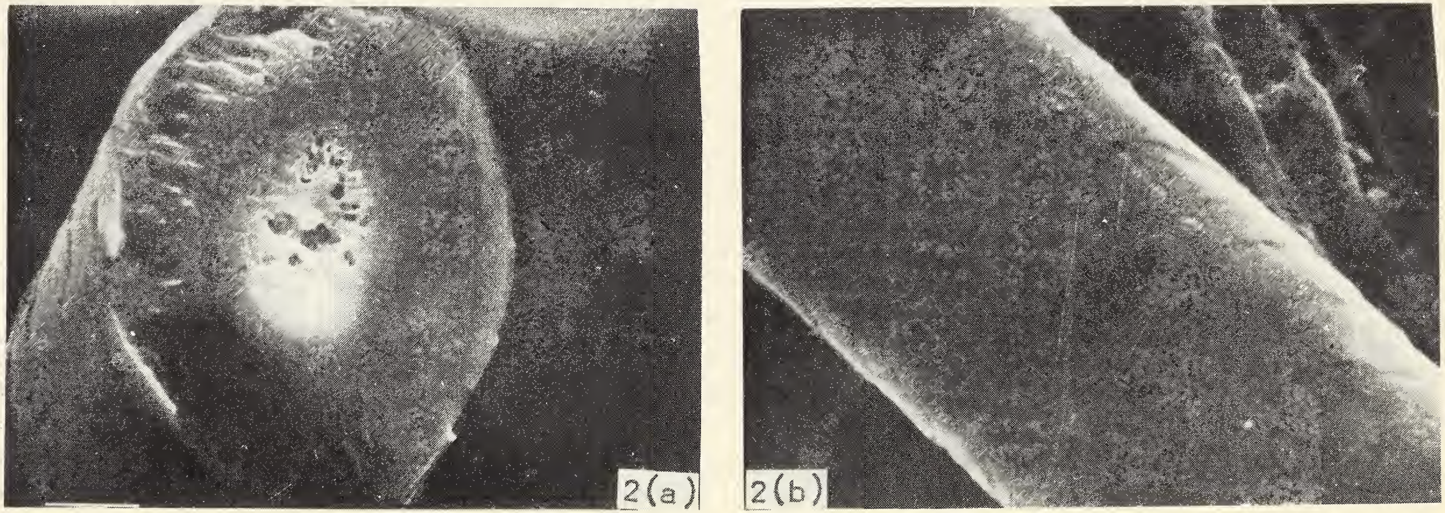
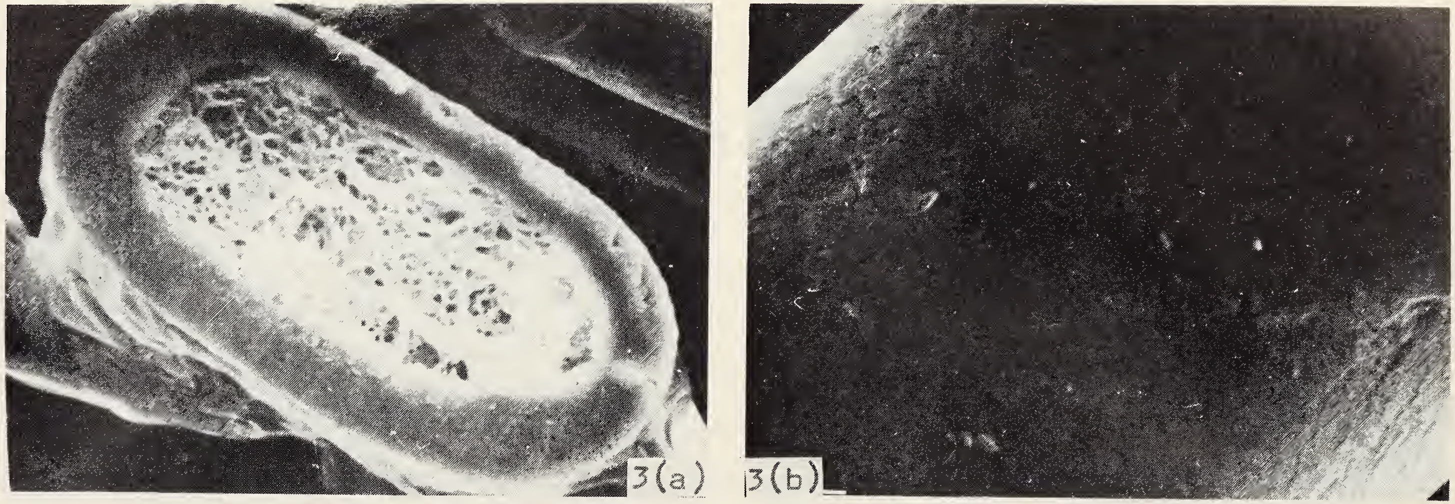


Fig. 1. Lion tailed macaque (*Macaca silenus*) — a. Cross section (X 475); b. Surface (X 800).
Fig. 2. Tiger (*Panthera tigris*) — a. Cross section (X 1200); b. Surface (X 1000).



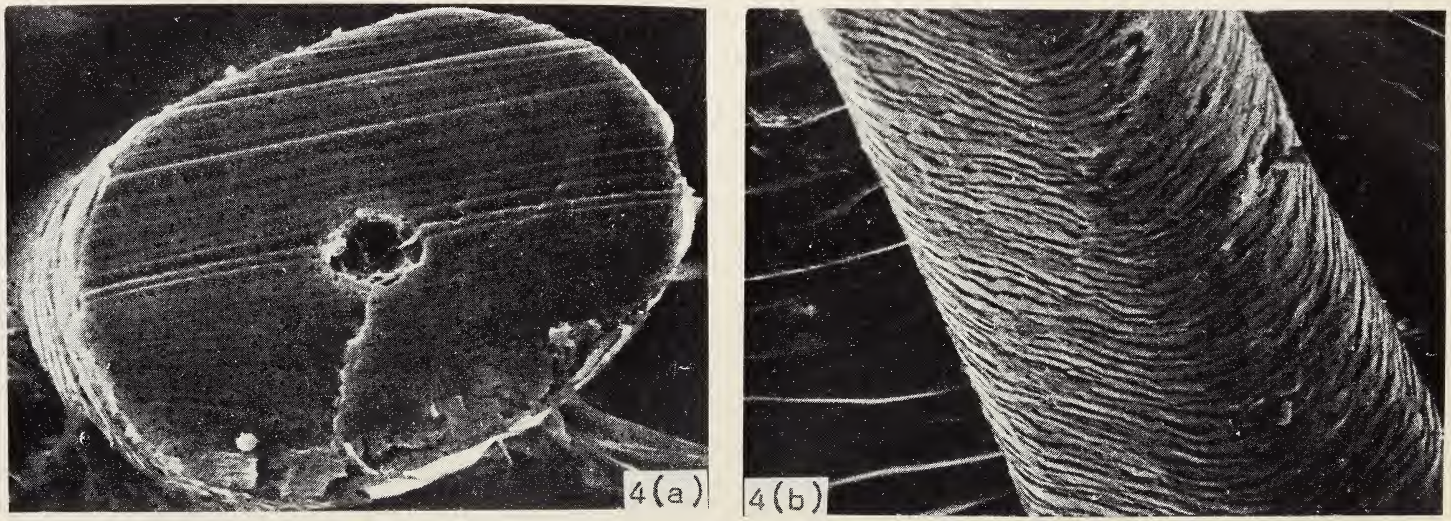
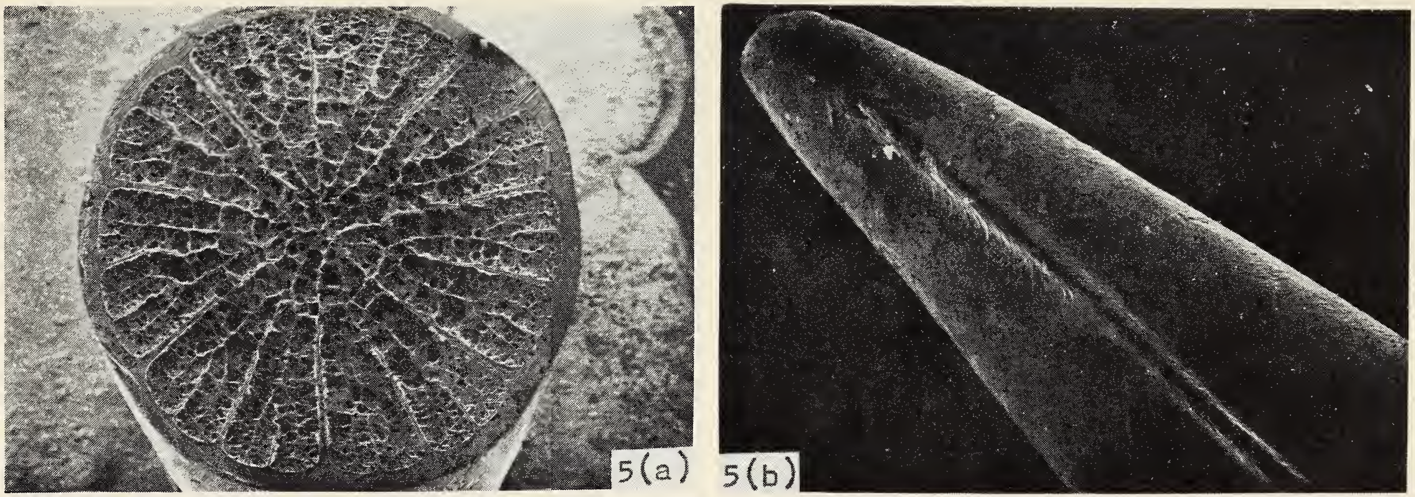


Fig. 3. Mangoose (*Herpestes edwardsi*) — a. Cross section (X 550); b. Surface (X 900).
Fig. 4. Sloth bear (*Melursus ursinus*) — a. Cross section (X 600); b. Surface (X 500).



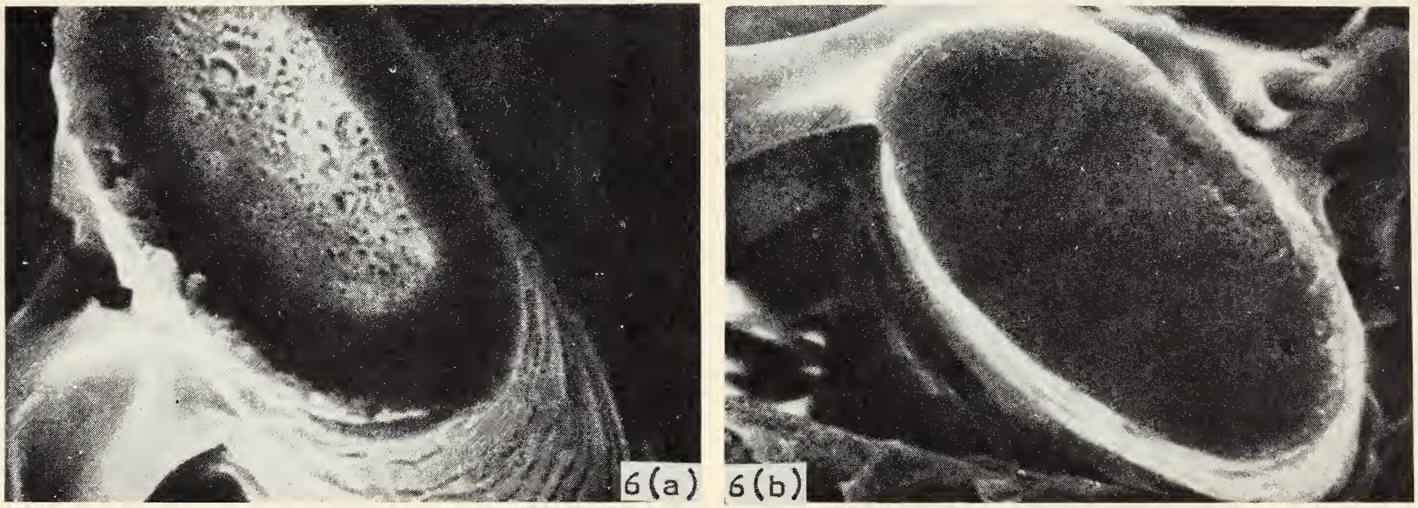
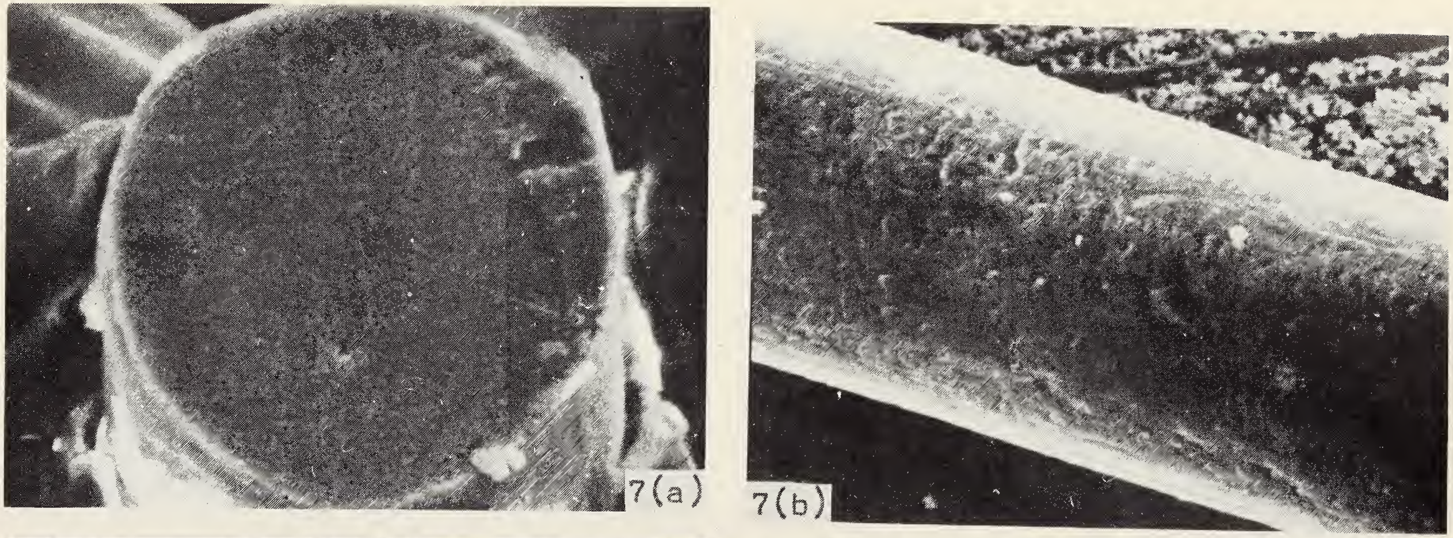


Fig. 5. Porcupine quill (*Hystrix indica*) — a. Cross section (X 15); b. Surface near tip (X 50).
Fig. 6. Cow (*Bos* sp.) — a. Cross section (X 1250); b. Cross section (X 1250).



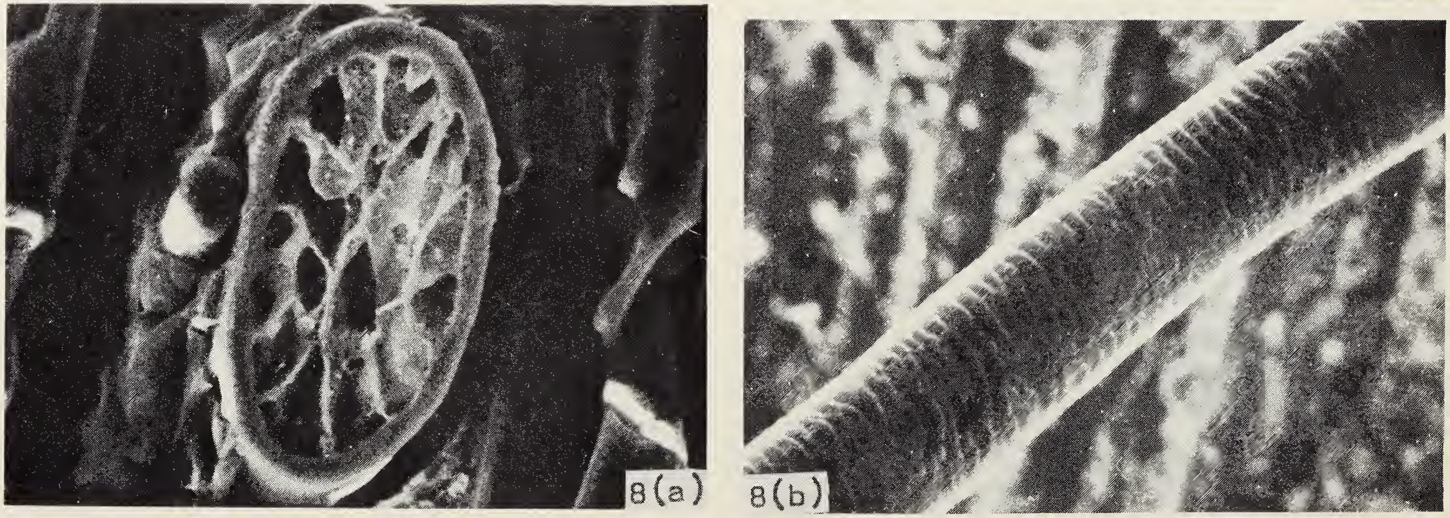
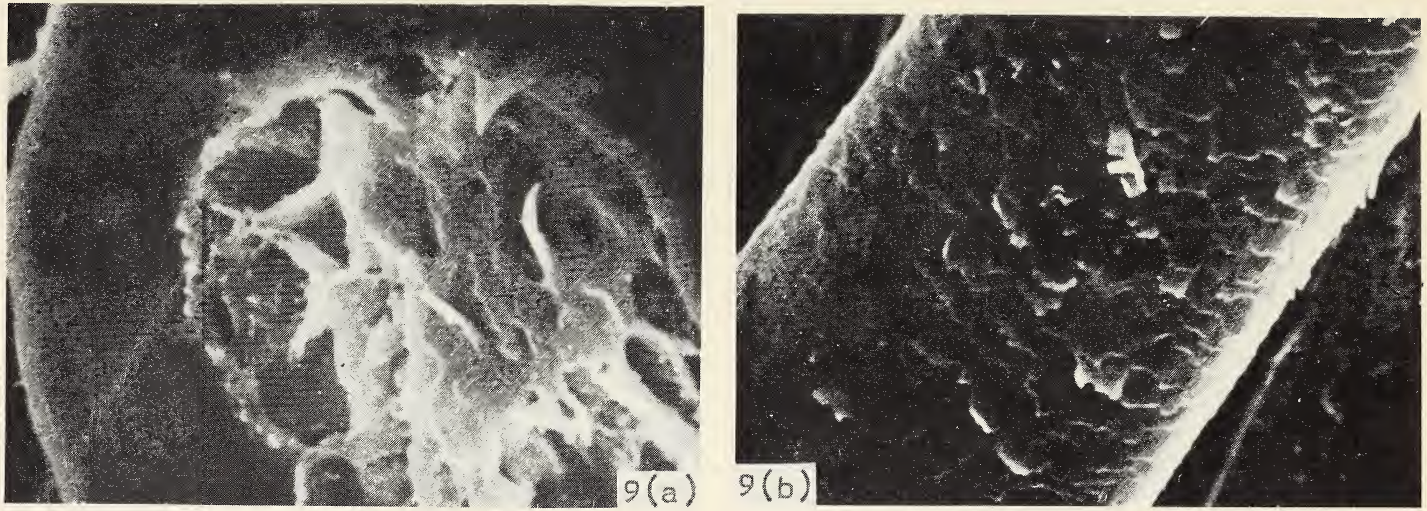


Fig. 7. Buffalo (*Bubalus bubalis*) — a. Cross section (X 600); b. Surface (X 450).
Fig. 8. Sheep (*Ovis* sp.) — a. Cross section (X 400); b. Surface (X 250).



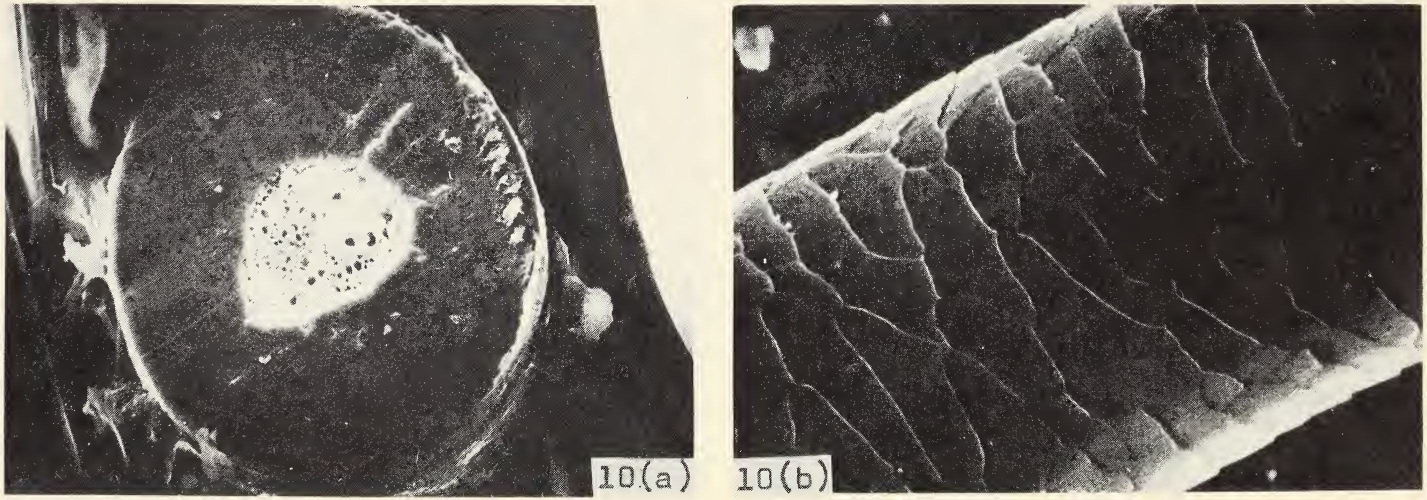
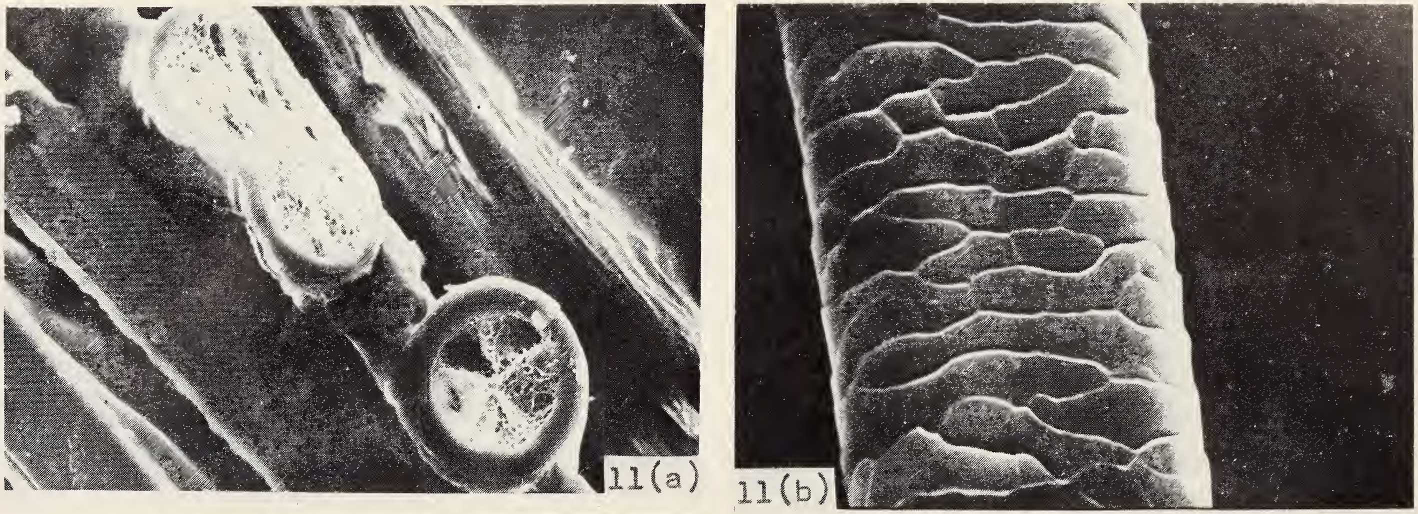


Fig. 9. Goat (*Capra* sp.) — a. Cross section (X 1100); b. Surface (X 500).
Fig. 10. Nilgai (*Boselaphus tragocamelus*) — a. Cross section (X 350); b. Surface (X 900) a & b, hair from nape.



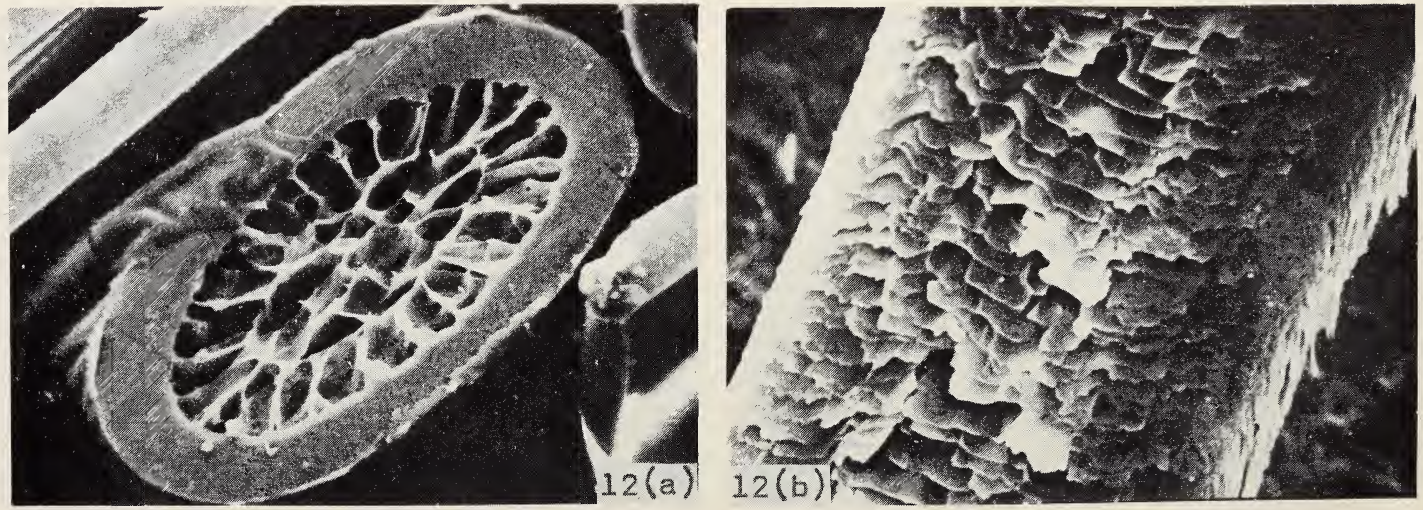
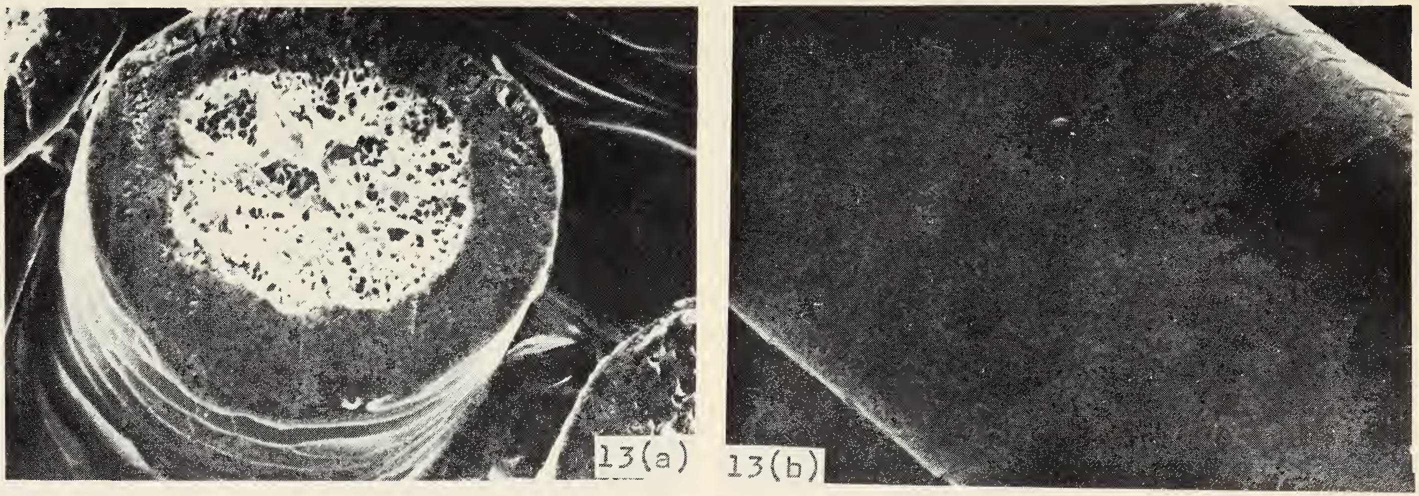


Fig. 11. Blackbuck (*Antilope cervicapra*) — a. Cross section (X 450); b. Surface (X 550).
Fig. 12. Sambar (*Cervus unicolor*) — a. Cross section (X 310); b. Surface (X 600).



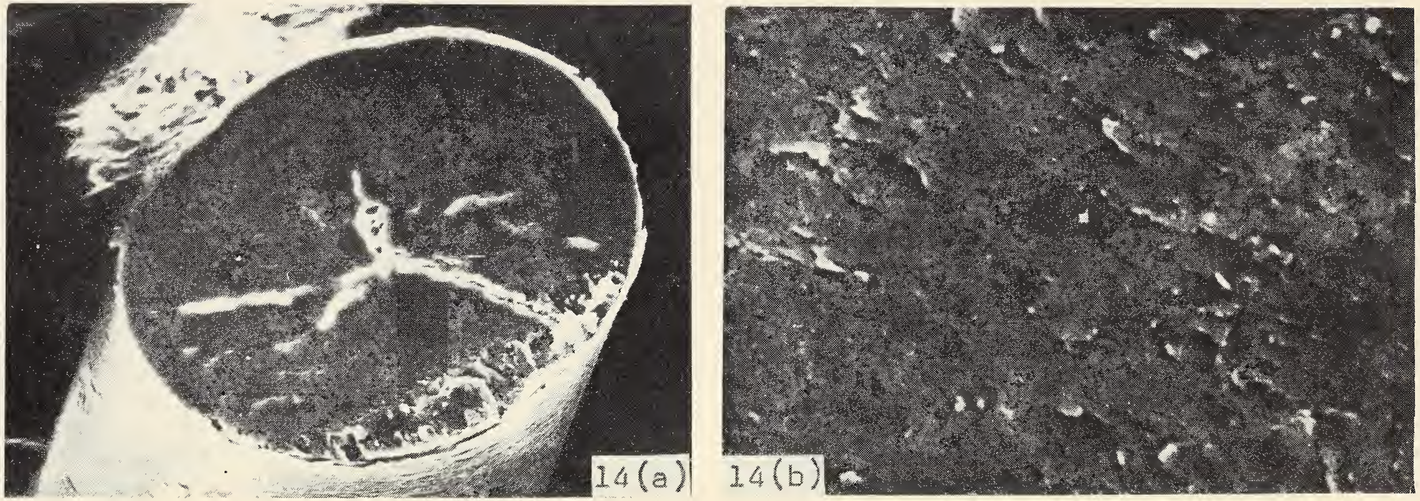
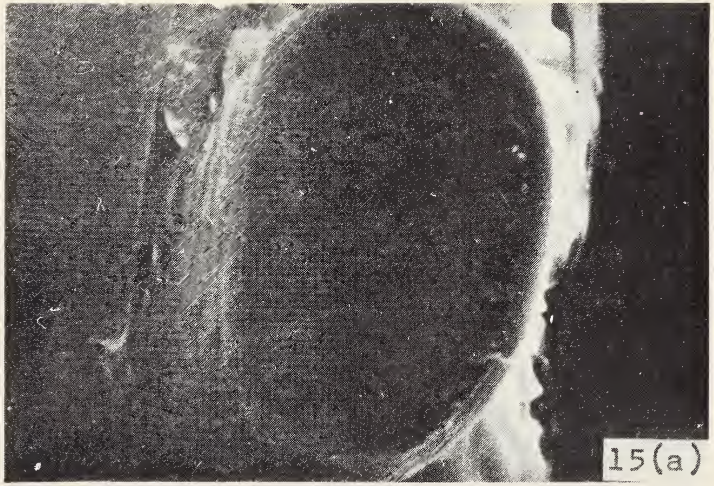
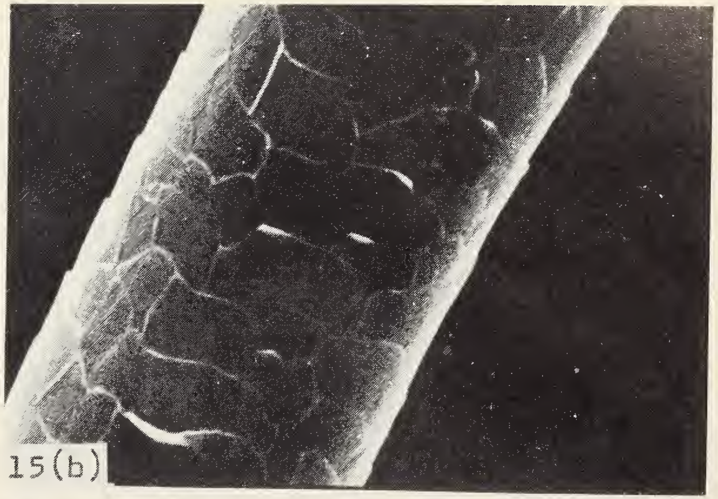
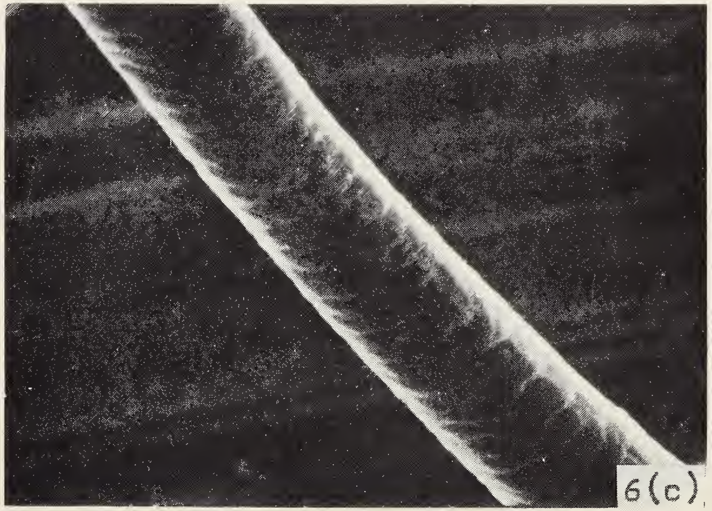


Fig. 13. Chital (*Axis axis*) — a. Cross section (X 700); b. Surface (X 900).
Fig. 14. Hog hair bristle from wild boar (*Sus scrofa*) — a. Cross section (X 250); b. Surface (X 1000).







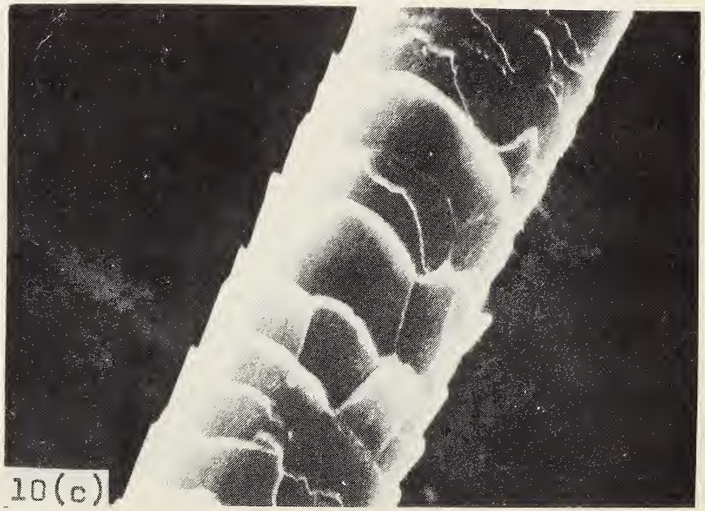


Fig. 15. Human — a. Cross section (X 900); b. Surface (X 900).
Fig. 6. Cow (*Bos* sp.) — c. Surface (X 500); Fig. 10. Nilgai (*Boselaphus tragocamelus*) — c. Surface of body hair.(X 1650)

bristles are widely used in paint brushes not only because they are stiff but also because their surface structure exhibits a very fine cuticular pattern (Fig. 14b) which is capable of retaining paint to the maximum extent. Some hairs exhibit a regular pattern in the structure of the medulla with a certain amount of symmetry being noticeable. Examples are porcupine quill (Fig. 5a), Sheep (Fig. 8a), Blackbuck (Fig. 11a) and Sambar (Fig. 12a). Sheep hair has little cortex. The large amount of air in the medulla would be an effective insulator against cold. Blackbuck hair (Fig. 11a) shows the presence of two types of hair; a circular one and a peanut shaped one which looks as if it is the fusion of two hairs. Nilgai (Fig. 10) has thicker hairs on the nape (a, b) and thinner ones on the body (c). The SEM does not show the differences in colour. Thus hair from nilgai male and female look the same and the various coloured hairs on the chital also look the same (Fig. 13). A detailed SEM study has been suggested (Reaney *et al.* 1978) as a taxonomical tool in the classification of birds. Perhaps this can be attempted for mammals as well, since the present study shows that considerable differences can be noticed in hair structure with the aid of the SEM.

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8. REDISCOVERY OF THE GREAT CRESTED GREBE (*PODICEPS CRISTATUS*) BREEDING IN GUJARAT

The Great Crested Grebe, *Podiceps cristatus*, has a discontinuous distribution in the Palaearctic, Ethiopian, Oriental, Australian (Tasmania, Australia and New Zealand) zones. In the palaearctic zone, the bird is a summer migrant in the northernmost parts of its range, seen throughout the year in the middle part of the range as far south as the Mediterranean basin, Black Sea and Near East, and a winter migrant in the southern parts of its range (Gooders 1978).

In the Indian region, the bird is known to breed only in Baluchistan (Khushdil Khan Lake) and Ladakh (Tso Kar) and possibly in Nepal; it is a winter visitor to northern India from Sind to Assam and Manipur, and south to Kutch and Orissa (Ripley 1982).

A single record of a nest with three eggs near Kharagoda, Gujarat, was made by Bulkley (1891) in August. Ali & Ripley (1968) states that there is some indirect evidence that odd pairs may breed irregularly in Gujarat and Saurashtra; however, there has been no authentic record of the birds nesting in our area in recent times. The present report records nesting of the bird in Saurashtra during 1984.

The observations were made in the Khijidia marshes (22° 32′N, 70° 10′E), declared now as a Bird Sanctuary, approximately 12 km east of Jamnagar, Gujarat. These are fresh water marshes that have been formed on the landward side of a stone-and-mud dyke that runs in a gently curved manner and is breached by two masonry spillways. The marshes are covered by large patches of dense reeds and grasses with interspersed open water patches. A large number of waterfowl and waders winter here every year and Coot (*Fulica atra*) and Purple Moorhen (*Porphyrio porphyrio*) nest here. During our visit on the 16 September 1984, we saw six adult Great Crested Grebes (*Podiceps cristatus*) in prime breeding plumage, which consisted of the upstanding blackish ear tufts and the chestnut coloured frills shading off into black on the sides of the head. These six birds were seen as three discrete pairs, each keeping to a separate patch of open water.

Prof. R. M. Naik advised us to revisit the place to pay close attention to the grebes and to look for evidences of its possible nesting. So we revisited the marshes on 30 September. This time we were equipped with a Carl Zeiss 16X telescope. First, we saw a pair of grebes with three chicks. The chicks were a little larger than the Little Grebes (*Podiceps ruficollis*) which were swimming conveniently nearby for a size comparison. The chicks had black and white stripes on the head and neck, and their back appeared dark — almost dull black. Swimming independently one chick even tried to climb on a parent's back. One parent fished out what appeared to be a small fish and offered it to the closest chick, but the young one was unable to swallow it and while manipulating it, let it drop into the water only to be picked up by the other parent who offered it again. All this time, a Little Tern (*Sterna albifrons*) hovered above hoping to get the fish.

Finally, the fish was dropped by the chick once again and it disappeared under water. Little later, one chick clambered onto the back of one of the parents and sat there while the other two chicks swam alongside.

As we walked a little ahead, we saw another family group of an adult with two chicks fairly closeby. On spying us, the group glided away, one chick abreast of the parent, the other trailing behind.

Further along, a third pair of adult grebes with three chicks were seen feeding near a family of Coots consisting of the adults and three chicks. The adult grebes seemed to obtain their food both by diving for it and by swimming forward, the body on the water while the head raked the water with the bill inside.

Ahead, we saw yet another pair of adults with three chicks and a single adult grebe floated about nearby.

On 4 October, Shivrajkumar Khachar, R.

M. Naik and Lavkumar Khacher accompanied us to the marshes and confirmed our identification of the grebes and their chicks. During this visit we once again saw the family groups of Great Crested Grebe, in the same area of the marshes where we had seen them earlier.

The Great Crested Grebe is known to live in colonies and small groups during the nesting season. In Europe, several nests of the bird may be found in the same piece of water and in Ladakh and Tibet, it breeds in colonies, many birds placing their nests within a few feet of one another (Baker 1929). The four family groups that we saw at Khijidia were confined to a relatively deeper side of the marsh, and since the family groups maintained a discreet distance we feel that the birds may have nested in a loose colony. Apart from the family groups, we also saw five individual adult birds in breeding plumage in the marsh, so that it seems possible that more than four pairs might have made an attempt at nesting.

Mr. Jumma B. Morya, a Forest Guard, reported some juvenile Great Crested Grebes in the Sanctuary in December 1983 and Mr. Lavkumar Khacher on checking this report, saw three pairs of adults with fully fledged juveniles; it was presumed that the juveniles may have come to Khijidia with their parents as migrants. From our observations of 1984 presented here, it seems possible the grebes may have bred there in 1983 as well.

On three separate occasions in May, June and July 1984, three, thirteen and seven birds respectively, in their breeding plumage were seen at Nyari dam reservoir on the outskirts of Rajkot city, but unfortunately observations on the birds at the reservoir could not be continued later on (A. K. Banerjee and Gopakumar, G., per. comm.). However, these observations at Nyari, combined with the nesting at Khijidia reported here, indicate that several Great Crested Grebes had stayed over in the Saurashtra region of Gujarat during the summer and monsoon of 1984. We look forward to an intensive search for these birds in the marshy areas of Saurashtra during the next nesting season.

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9. LEAPFROGGING IN CATTLE EGRETS (*BUBULCUS IBIS*)

During fieldwork in Kanha Tiger Reserve (Mandla District, Madhya Pradesh; 1980-82) cattle egrets (*Bubulcus ibis*) were commonly seen feeding alone, in loose flocks, or in association with domestic and wild ungulates. However, during a two week spell of the hot weather, dense communally feeding flocks were observed to move forwards with a rolling motion, termed 'leapfrogging' by Meyerriecks (1960), which does not appear to have been recorded for this species in Asia (Ali & Ripley 1968, Cramp & Simmons 1977).

Between 14-28 May 1980 large cattle egret flocks (50-70 birds), mostly in breeding plumage, were frequently observed from Upper Rest House varandah, Kanha Village, 'leapfrogging' in the early morning, whilst foraging in sal (*Shorea robusta*) forest litter. On one occasion 70 egrets, in a flock with inter-individual distances of half to one metre progressed linearly forwards for 75-100 m across a 20 m front. Movement of the flock was accomplished by rear birds flying forwards in semi-synchrony and landing about 1 m in front of the leading birds. The egrets thus exposed at the rear flew forwards, in turn, to become the temporary leaders. This rolling flock motion was accompanied by considerable rustling of the little and frequent pecking and lunging at disturbed prey, probably orthoptera and *Mabuya* skinks, which occur at high density among the leaves. The flock feeding was terminated within 15 minutes by dispersal of the birds. Initiation of the rolling flock was not observed. Similar behaviour was noted by Meyerriecks (1960) for cattle egrets feeding on pasture in Florida and by R. Lamprey (pers. comm.) in Kenya.

The leapfrogging birds may have higher feeding rates, in comparison to those foraging alone or in loose flocks, when feeding on dense prey, as a result of mutual disturbance and exposure of food items. As the orthopteran and lizard prey flee forwards from a disturbance, 'leapfrogging' may arise from the rear birds of a dense flock flying forwards from the depleted food patches to the band of conspicuous moving prey in front of the flock, i.e. there may be strong competition to be in the front rank. The occurrence of leapfrogging only during May 1980 may have been related to the effects of this unusually dry month on food availability. Leapfrogging might be expected to be frequent among flock feeding birds whilst foraging on mobile, densely packed prey. However, Murton & Issacson (1962) reported similar behaviour in the granivorous wood pigeon (*Columba palumbus*) feeding in stubble and clover. In this case leapfrogging may have arisen as anti-predator behaviour; birds at the rear of the flock being more vulnerable to predation than those at the front.

I am greatly indebted to the Madhya Pradesh Forest Department/Project Tiger and Department of Agriculture, New Delhi for permission to work in Kanha and for their marvellous cooperation. I am very grateful to Mungal and Mohan Baiga for their field assistance and to Dr Euan Dunn, Mike Wilson, Allen Stevens and Martin Kelsey for comments on this note. The fieldwork was funded by the SERC (UK).

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10. INVASION OF WHITE STORKS (*CICONIA CICONIA*) IN KACHCH (KUTCH), GUJARAT

Spotting White Storks numbering from 2 to 20 along jheels or heavily watered agricultural fields or gram fields is a common feature. Besides flamingos and Demoiselle cranes, a flock of over 25 of other big birds is rarely seen in the Western part of India.

I, however, had two occasions to see large congregations of White Storks. On 22-01-1984, when I was organizing a census of cranes in the Kachch (Kutch) area, at Vandhai pond in Bhachau Taluka of Kachch district, I suddenly came across a large flock of White Storks. This was disturbed by my sudden appearance. All the birds flew up and spiralled upward above the pond to a great height for the next 15 minutes. The exact number then counted was 148.

The second occasion came more recently. On 02-12-1984 when I had planned to visit the famous Dhand area located near the desert border of the Great Rann of Kachch with Shri H. L. Lalka, Dy. Conservator of Forests. Because of the late rains the entire Dhand was still marshy and supported a heavy growth of reeds and rushes 60 to 90 cm tall.

This somewhat semi dried area with jheels has become an ideal site for White Storks and Demoiselle cranes. It is perhaps one of the biggest congregating grounds of White Storks and to my astonishment the number counted by us at one time in a limited area which was visible to us was 904. From the flocks flying overhead the approximate number of White Storks in the Dhand would probably be over 3000. The number of Demoiselle crane in this could not have been less than 10000.

I do not know whether such a large congregation of White Storks has been observed at one site anywhere in India.

CONSERVATOR OF FORESTS,
KACHCH CIRCLE,
BHUJ,
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A. A. VAIDYA

11. RISE IN GLOBAL MEAN SEA LEVEL HAS IT AFFECTED THE FLAMINGO BREEDING GROUNDS?

Ornithologists have been baffled as to why the Flamingos have not been breeding since 1977 in their traditional breeding grounds in the Great Rann of Kachch at Sindalbet in

Flamingo City (Thakker 1982). Satellite photos have pointed to unfavourable conditions for breeding during the usual season September to April. These photos indicated deep sea during in December/January and absence of shallow water in April (Thakker 1982). The Flamingos have been breeding in the Great Rann of Kachch since 1893. Why did they find the place unsuitable only in 1977? The explanation most probably lies in the steady rise in sea level that has taken place since the rise of industrial civilization founded on the running of machines on fossil fuels and the socio-political changes which are causing a steady destruction of Tropical forests.

The fossil fuels release carbon dioxide into the atmosphere, on burning. Similarly the destruction of forests results in release of carbon dioxide into the atmosphere. The application of chemical fertilisers to fields and the dumping of sewage into the sea and rivers are among the causes for release of gases similar in effect on the atmosphere as carbon dioxide namely effecting a heating of the earth causing the polar ice caps to melt. This in turn raises the mean sea level. This causes inundation of low lying lands disturbing the balance of life. The Kachch area is an example of a wetland area which might have been affected by this rise in sea level. The surest indication of this could as well be the displacement of the breeding grounds forcibly from Flamingo City in Sindalbet to Thol lake Sanctuary 600 km away in Ahmedabad. The article offers an explanation to this effect.

Data on sea level rise

Sea level on a global basis has been rising since the turn of the century. Between 1890 and 1980 the global mean sea level has risen by about 16.5 cm. (Etkins and Epstein 1982).

The nesting season in the Great Rann of Kachch depends upon the requisite shallowness of water on the nesting ground September/October, February to April. The Nest: A truncated conical mound of hard sun-baked mud 15.24 to 30.48 cm in height with a slight pan-like depression at top is built in hundreds close to one another in a compact, expansive 'city'.

The sea threatened to submerge an appreciable number of nests of the Flamingos and hence they fled the Sindalbet area.

We reach the above result by following a line of argument similar to the one below:

From the nest height data the height varies between 15.24 cm to 30.48 cm. The reason for this variation in height could be to adjust to the upper and lower levels of the tides around the mean sea level, so that the nests are not inundated. Thus so long as the mean sea level did not appreciably change with time the above nest 'design' levels sufficed to provide a set of secure homes for breeding during the few months the Flamingos made Sindalbet area their land. So also the various other creatures in the food chain remained more or less satisfactory in the area. As soon as a critical global mean sea level was reached this ecological balance was upset and the changes in the tidal levels around this new critical mean sea level no longer remained below submergence of a critical number of nests. Thakker (1982) notes that the Great Rann of Kachch breeding ground is approximately one meter above mean sea level. Thus, assuming that this is the 1977 sea level, the variation of tidal changes around this level, could no longer sustain the ecological conditions that prevailed prior to this year. This could be inferred from the following concept that could have been built into the Flamingos' minds over a period of time: If the nests were built with a minimum height of 15.24 cm, then the tidal effects could be overcome and the young could be nurtured in safety.

We know that the Flamingos have been breeding in Sindalbet since 1893. And we also know that the rise in the global mean sea level till 1977 has been about 16.5 cm. Thus the mean sea level rose sufficiently to violate the 15.24 cm minimum nest height principle so as to indundate an appreciable number of nests to invoke a fast response from the Flamingo community. And indeed it appears that the response has been an emergency one. But we can only tell after a detailed ecological study of two areas: the Gulf of Kachch ecosystem and the Thol lake sanctuary area in Ahmedabad.

CONCLUSION

The Flamingo breeding ground change could be an indicator of the type of ecological changes that could have been really man made. The rapid build up of greenhouse gases in the atmosphere could be compressing a 125000 year climatic change in just 120 years. Man must himself bear the burden of backtracking from this way of life as soon as possible — now: willingly.

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12. COURTSHIP BEHAVIOUR OF PAINTED SNIPE IN TIRUCHIRAPALLI, TAMILNADU

I observed two instances of Courtship behaviour in the painted snipe (*Rostratula benghalensis*) one in December 1981 and another in November 1982. On both the instances there were two males and a female each. On the first instance the female displayed to her mate (presumably) at 5.50 p.m. flapping up the wings. They both stood back to back a few feet apart and the hen cooed: oonkun, oonkun, oonkun, puffing up her nape. As the male turned to move toward her another male appeared and, coming within a few feet in front of her, hopped three steps forward. At this stage the first male ran towards him and pecked at him at which the latter flew a few feet away. But as the pair were again getting ready for courtship, the second male reappeared before the female only to be caught up in a real fight with the first male to whom he lost again. This continued into dusk and darkness. On the second instance, a second male followed a pair at a distance of about 25 feet at 6.15 a.m. The male that was close to the female, apparently already paired, took a few steps, his neck stretched and beak held forward, towards the second male. The intended attack was aborted as the intruding male increased the distance between them. All this time the female was at the incomplete nest, preening, the first egg not yet laid. The pair were not to be left alone, for at 8.40 a.m. the second male (or a different one?) appeared behind the hen who gave him what appeared to be a mild peck. Then he followed her, now walking so close as to give one the impression that he was the rightful mate. At this her mate hurried along the path that the hen and second male had been taking as if for a fight. However the second male made his escape, walking past the female.

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13. SOME STORM-BLOWN PELAGIC BIRDS IN POINT CALIMERE

The occurrence of pelagic birds on the Indian coastline has almost invariably been associated with cyclonic storms accompanied by strong winds. A cyclonic depression in the Bay of Bengal from the 22nd to 25th December 1983, the cause of heavy and continuous rain throughout Thanjavur district resulted in three very interesting such sightings at Point Calimere (10° 18′N; 79° 51′E) in Thanjavur district, Tamil Nadu on the 23rd morning. Two of these, the Lesser Frigate Bird (*Fregata minor*) and the Lesser or Whitecapped Noddy (*Anous tenuirostris*) are perhaps the first records for the east coast.

Lesser Frigate Bird (*Fregata minor*):

At 0845 hrs on the morning of 23rd December while we were standing near the mouth of a creek on the southern shoreline of Point Calimere Sanctuary, a completely dark Frigate Bird, followed after a few minutes by another in the same plumage flew over at *c.* 100 feet; at 1030 hrs, one of them again came directly over us, and soared, circling on motionless wings for five minutes; the characteristic 'frigate bird' silhouette, as also the long, hooked bill left no doubt about their generic identity. The uniformly dark plumage (contra varying amounts of white on underparts) later diagnosed their identity as males of this species.

In a separate observation on the same day at 1200 hrs one of us (SAR) recorded seeing a 'frigate bird with some white on underparts', on an inland freshwater body surrounded by forest, *c.* 3 km from the above sightings. This could have been a female of the same species.

While we were talking to fishermen the following day, they described seeing a bird in the afternoon of the 23rd, which must almost certainly have been one of the frigates; it had settled on the beach, and again on top of the lighthouse (*c.* 40 feet).

There are only three previous confirmed sightings of this bird within Indian limits (Taylor 1953), all 3 in Bombay during the SW monsoon — June 29th and July 5th 1953. The only Indian specimen is a storm-blown example entangled in a fishing net off Quilon on the Kerala coast, also during the SW monsoon. The present record is thus the first for this species for the Indian East Coast.

Sooty tern (*Sterna fuscata*):

A single adult tern with contrasting dark upperparts, pure white underparts, and deeply forked tail was first seen at 0830 hrs on the

23rd morning, flying along the shoreline (SBC, PBS, VNR). It then drifted inland towards the thorn-scrub where it was again sighted by one of us (SQA), flying at about 50 feet; it was then traversing a wavy flightpath, weaving its way in such a manner as to stay over the open ground and not fly over the *Prosopis juliflora* bushes. The contrasting dark grey and pure white plumage along with a relatively long neck, swept-back tapering wings with a white dorsal leading edge, and elongated outer-tail feathers in the deeply forked tail were noted as diagnostic field characters, confirmed from INDIAN HANDBOOK as characteristic of the species.

The Sooty Tern has previously been recorded once from Point Calimere, substantiated by a specimen (Ambedkar 1983).

Lesser or Whitecapped Noddy (*Anous tenuirostris*):

Three birds seen initially identified as the Brown Noddy (*Anous stolidus*), but later confirmed from photographs taken at the time as this species by Dr. Tony Diamond. First seen by us at 0815 hrs on 23rd December and subsequently by several observers including Dr. R. Sugathan, Senior Field Biologist, Avifauna Project, BNHS and Ms. Elizabeth Forster, a British birdwatcher.

The three birds included a sub-adult with the silvery crown much less pronounced, and feathers of the nape and hind neck edged pale buff. One aspect of the plumage in the two adults that we have not been able to find in the literature was the presence of prominent blue-grey patches suffused with the dark brown on the hind neck, very conspicuous at close quarters. Ali & Ripley (HANDBOOK Vol. 3 p. 73) have mentioned the 'white forehead passing into ashy grey and then into dark brown on nape'. The two adults on record had prominent blue patches which stood out from the surrounding brown plumage, and were almost identical in both birds. These were observed at a distance of a few inches between 0915 and 0930 hrs while they rested, obviously exhausted on the shore.

When first sighted at 0815 hrs in clear bright weather all three birds were actively feeding over 2 to 3 feet deep water *c.* 50 m from the mouth of a creek. The birds were foraging very actively even in the warm sun suggesting that due to strong winds they had been unable to feed for a long time. They were foraging by hovering 2 to 3 inches over the slightly rippled water surface while holding their bodies at a 45° or greater angle to the surface, thus appearing as if standing on their tails! On sighting a shrimp or small fish near the surface the whole body would be flicked forward describing a half loop, the bill touching the water first; they would then often land in the water momentarily before taking off again. Feeding in this manner the three birds appeared to have staked out individual 'beats' and worked these upwind (inland) before flying back to the mouth of the sea and starting again. They were exceedingly unwary and when feeding near the bank of the creek did not shift at all to avoid the three observers 10 feet away on the shore. A harsh *Krr-ak* call was uttered sometimes while hovering or flying downwind. Ali & Ripley (ibid.) do not have any records of calls or other habits for this species from Indian waters. The calls recorded by us were bi-syllabic with a distinct emphasis on the first syllable. At 0900 hrs, after they were observed feeding for *c.* 45 minutes all three settled within 2 m of each other on the opposite bank from the observers, where there was a small flock of little terns (*Sterna albifrons*) initially. They were undisturbed and began to preen while two of us crossed the 100 feet wide creek immediately after they had settled. Preening was vigorous over the flight feathers and tail, breast was also preened to a lesser extent. One three-quarter grown rectrice with the sheath still attached was seen in the sub-adult. After about 15 minutes it became apparent that they were completely exhausted, and made no attempt to move, even when sat down beside and photographed from a distance of a few inches.

We thank Dr. A. W. Diamond for his help in identifying the Whitecapped Noddy.

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S. ALAGAR RAJAN
P. BALASUBRAMANIAN
V. NATARAJAN
SHAHID Q. ALI

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14. PARAKEET, *PSITTACULA KRAMERI* (SCOPOLI), DAMAGE TO CITRUS FRUITS IN PUNJAB, PAKISTAN

(*With two text-figures*)

INTRODUCTION

The rose-ringed parakeet, *Psittacula krameri* (Scopoli), has very wide distribution over almost the whole of India, Pakistan, Bangladesh, Nepal, Central Burma and Sri Lanka (Ali 1977). In recent years it has become extraordinarily abundant in the canal irrigated and rainfed areas of Pakistan and does serious damage to agricultural crops such as cereals (maize), oil seeds (rape seed and sunflower) and fruits (guava, mangoes and citrus). This parakeet inhabits cities, gardens as well as woodlands, scrubland and cultivated areas. They are indiscriminate in feeding habits and can eat grains, seeds, nuts, cooked and raw vegetables, seeding weeds, fruits and berries (Smith 1972 and Qureshi 1980).

In Punjab many varities of citrus fruits are widely cultivated. Ten species have been described from Pakistan (Din and Shahina 1980). Of these *Citrus sinensis* (Linn.) Osbeck (sweet orange or malta) and a *Citrus* variety locally called as Kinno are highly susceptible to bird damage. Parakeet is the major bird pest damaging these fruits.

Parakeet damage to cereal crops and some fruits has been reported by many workers but no information on damage to citrus fruits is available (Ramzan & Toor 1972, De Grazio 1978 and Bashir 1978). Due to the seriousness of the problem a survey was conducted

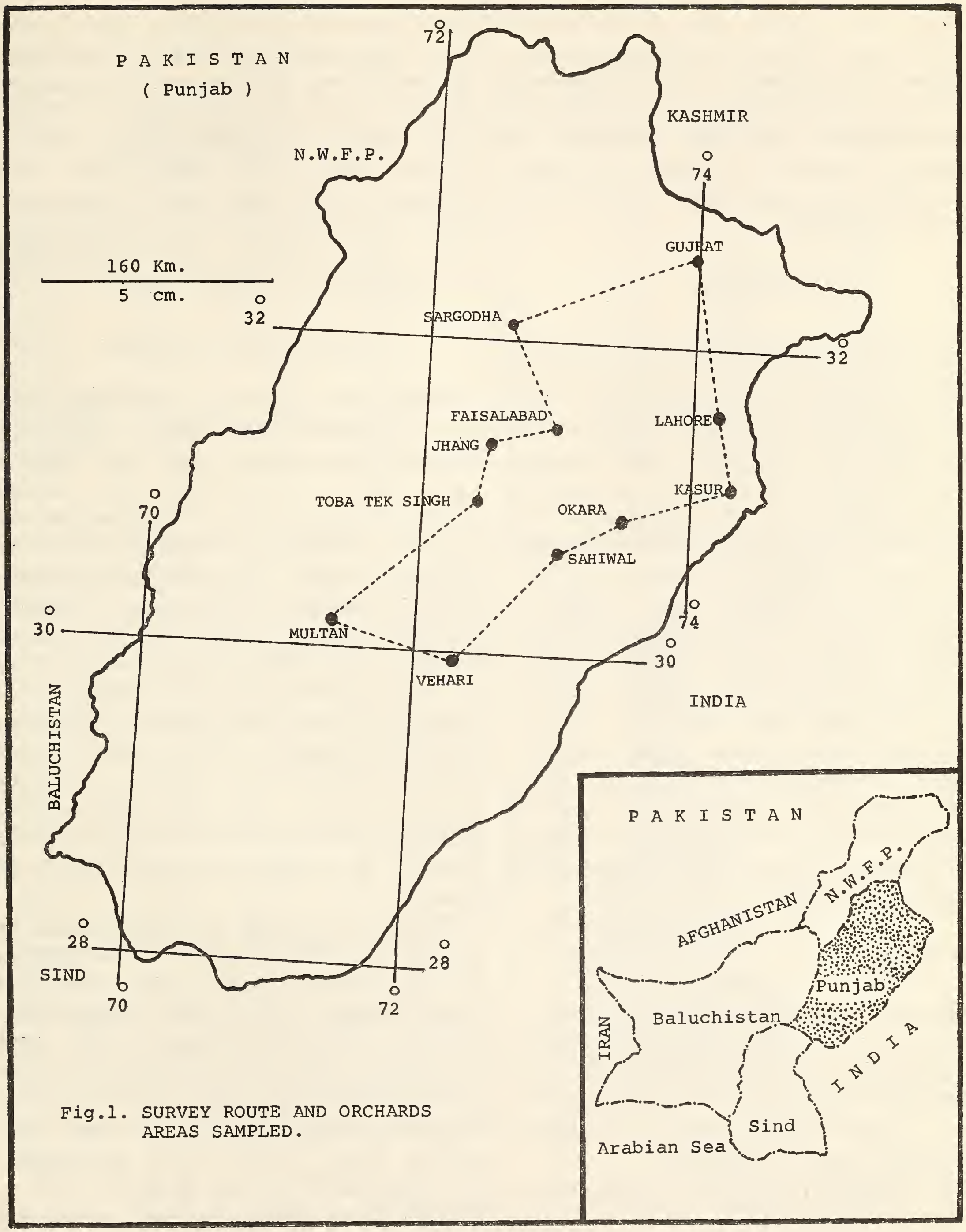
PAKISTAN
(Punjab)
N.W.F.P.
KASHMIR
160 Km.
5 cm.
GUJRAT
SARGODHA
FAISALABAD
JHANG
LAHORE
KASUR
TOBA TEK SINGH
OKARA
SAHIWAL
MULTAN
VEHARI
INDIA
BALUCHISTAN
SIND
72°
74°
32°
70°
30°
28°
PAKISTAN
AFGHANISTAN
N.W.F.P.
Punjab
Baluchistan
IRAN
INDIA
Sind
Arabian Sea

Fig.1. SURVEY ROUTE AND ORCHARDS AREAS SAMPLED.

Fig. 1.

in major citrus growing areas of central Punjab. The main objective of this study was to ascertain the magnitude of the problem and as a follow up to develop control methods to minimize these losses. The information on damage and losses to citrus fruits due to parakeet in this paper are being reported for the first time in Pakistan.

METHODS

The survey was carried out in the first three weeks of February, 1983 when the fruits are ripe. The survey was conducted along a predetermined route in the major citrus growing areas (Fig. 1). Along this route sampling points (orchards) were picked up at intervals of 20-40 kilometres. After selection of the orchard, ten percent of the fields were sampled and from each field, ten percent tree rows were selected at random with the help of random numbers. In the selected tree rows, the first tree was sampled on the right side and the second tree on the left side and vice versa. From each side, branches on the top, middle and lower portions of the tree were observed for damaged and undamaged fruits. Fallen and damaged fruits under each tree were not accounted for over all percentage damage. The percentage damage was calculated using the following formula:

$$\% \text{ damage} = \frac{\text{No. of damaged fruits} \times 100}{\text{Total no. of fruits.}}$$

Fifty four orchards covering an area of 259 hectares were selected for survey in 11 districts of Central Punjab. Out of this 34 hectares (88 fields) were sampled for damage survey. Due to logistic problems districts of Bahawalpur division were not surveyed.

The damage to citrus fruits by parakeet was recorded by observing the characteristic sign of damage which was the size of injury in relation to beak size of the parakeet. This injury was mostly one inch or more in depth and about two inches in width. This was the primary criteria for differentiating parakeet damage from other birds. The fruits damaged by other birds such as red-vented bulbul, *Pycnonotus cafer* and common house crow, *Corvus splendens* were discarded and not accounted for damage estimates.

RESULTS AND DISCUSSION

Damage survey results for each district visited are summarized in Table 1 which show that the average damage was 8.62% while it varied from 2.57-12.71%. The heaviest damage was recorded in Faisalabad district (12.71%) followed by Vehari (12.53%) and Gujarat (10.63%). The major bird pest causing this damage was parakeet, *P. krameri* (Scopoli) while house crow, *Corvus splendens* and red-vented bulbul, *Pycnonotus cafer* feed on the damaged fruits. It was observed that parakeets forage in small parties of four to ten which band together in large flocks in and around orchards. The foraging and feeding activities had two peaks, one in the morning roughly from 6.30 to 10.30 hours and the other in the evening from 16.00 to 18.30 hours.

The heaviest damage was recorded with an average of 21.76% (Range 6.73-34.73%) on the top branches while on the middle and lower branches it was 5.64% (Range 1.74-10.18%) and 0.39% (Range 0.02-1.13%) respectively. This pattern of damage by the roseringed parakeet to citrus fruits has been observed by other workers also to other fruits such as peach, *Prunus persica* and almond, *P. amygdalus.* Toor and Sandhu (1981) recorded 61.1% damage to peach on the top

TABLE 1

DETAILS OF PARAKEET, *Psittacula krameri* (SCOPOLI), DAMAGE TO CITRUS FRUITS IN PUNJAB, PAKISTAN

District	Area of selected orchards (Hectares)	Area surveyed (Hectares)	% Damage in the canopy			Total No. of fruits		% Damage
			Top	Middle	Lower	Damaged	Undamaged	
Lahore	8	1	6.73	1.74	0.25	64	2430	2.57
Kasur	16	2	9.76	2.32	0.37	203	4896	3.99
Okara	27	3	16.52	5.54	0.89	438	5108	7.90
Sahiwal	35	4	19.02	4.85	0.26	1017	11441	8.17
Multan	36	4	24.34	6.43	0.26	1030	10134	9.23
Vehari	20	2	29.41	10.18	1.13	689	4810	12.53
Jhang	21	2	23.87	4.16	0.49	397	4215	8.61
Toba Tek Singh	14	1.5	25.19	7.73	0.16	531	4539	10.48
Faisalabad	14	1.5	34.73	8.40	0.17	382	2625	12.71
Sargodha	40	10	22.24	4.11	0.02	962	11090	7.98
Gujarat	28	3	27.53	6.63	0.34	1029	8653	10.63
Mean Average (%)	—	—	21.76	5.64	0.39	—	—	8.62

branches as against the 5.3% on the lower branches. Sandhu and Dhindsa (1982) observed the parakeet damage to almonds where they found 11.76% on the top branches while it was 1.83% on the lower ones.

In the present study majority of the orchards suffered damage within a range of 6-15% while there were only five orchards where it ranged from 16-20% (Fig. 2).

In South America, monk parakeet, *Myopsitta monachus,* damage a variety of fruits in Argentina, Bolivia, Brazil, Paraguay and Uruguay. Psittacids, also attack mangoes in Hondurus and Mexico (De Grazio and Besser 1970).

Ramzan and Toor (1972) studied the parakeet damage to guava in Ludhiana (India) which ranged from 13.8-26.6% average being 20.07%. Bashir (1978) also estimated guava fruit losses upto 75% in Punjab and Sind (Pakistan).

The citrus fruits have attained a very high importance in recent years in the over all

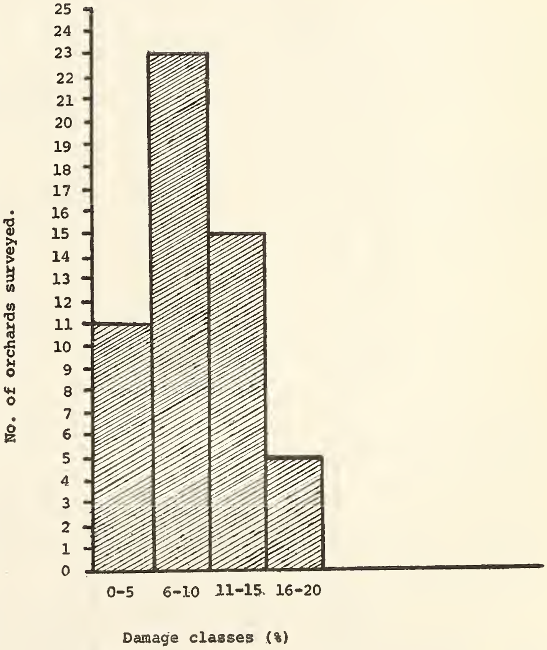

Fig. 2. Frequency distribution of parakeet damage to citrus orchards in Punjab.

TABLE 2

AREA, PRODUCTION AND EXPORT OF CITRUS FRUITS IN PAKISTAN

Year	Area (Hectares in ,000)					Production (M. Tons in ,000)					Export	
	Punjab	Sind	N.W.F.P.	Baluchistan	Total	Punjab	Sind	N.W.F.P.	Baluchistan	Total	Quantity (In M. Tons)	Value (In '000 Rs.)
1975-76	58.4	2.1	2.4	0.2	63.1	625.7	25.1	19.4	0.9	671.1	—	—
1976-77	69.5	2.2	2.5	0.2	74.4	662.8	27.3	20.2	1.0	711.3	89,342	111,160
1977-78	73.9	2.9	2.7	0.3	79.8	565.0	34.5	22.5	1.1	623.1	34,219	54,306
1978-79	65.9	3.0	3.0	0.3	72.2	677.5	33.7	24.8	0.3	736.3	57,731	84,442
1979-80	80.3	3.1	3.0	0.3	86.7	810.0	34.0	25.5	1.1	870.6	55,394	102,640
Average 5 Years	69.6	2.7	2.7	0.3	75.3	668.2	30.92	22.48	0.88	722.48	59,171.5	88,137
1980-81	87.7	3.3	3.1	0.4	94.5	864.3	34.3	26.3	1.3	926.2	20,342	39,834

SOURCE:

1. Agricultural Statistics of Pakistan Ministry of Food, Agriculture, Cooperatives and Agricultural Research.
2. Department of Agricultural & Live Stock Products Marketing and Grading.

complex of horticulture development in Pakistan. The area under cultivation, annual production and export have increased tremendously (Table 2). Among these *C. sinensis* (Linn.) Osbeck and Kinno variety are of high commercial value both for local consumption as well as for export. The sweet orange, with three varieties — Bloodred; Washington Navel and Mosambi (Mozambique), are some of the most popular of citrus fruits extensively consumed as fresh fruit, in juices, squashes etc. Damage of 8.62% is highly significant economically. Economic losses based on present survey are calculated as follows:

(Based on 1980-81 production statistics of citrus in the Punjab).

This huge economic loss to citrus fruits due to parakeet occurs in spite of traditional control methods adopted by the farmers such as the use of fire crackers and sling shot. To minimize these losses to the benefit of fruit planters different and appropriate control methods should be evaluated and developed.

ACKNOWLEDGEMENTS

We thank the Punjab Agricultural Extension Services for cooperation during the course of this survey.

— Total production = 864300 metric tonnes
— Estimated loss = 8.62%
— Then loss in quantity = 74503 metric tonnes
— Price of one metric tonne in local market = Rs. 2750.00
∴ — Loss value in local trade = Rs. 204.88 million
— Export price of one metric tonnes = Rs. 1958.00
∴ — Loss value in foreign trade = Rs. 145.88 million

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15. NOTES ON ORANGE PARROTBILL (*PARADOXORNIS NIPALENSIS*), BLACKFACED FLYCATCHER-WARBLER (*ABROSCOPUS SCHISTICEPS*) AND PURPLE COCHOA (*COCHOA PURPUREA*) FROM GARHWAL HIMALAYAS

In May-June 1984 I participated in a natural history trek in Garhwal Himalaya, which was partially sponsored by the Society. We trekked from Dhodital (Near Yamnotri) to Kedarnath via Uttar Kashi Belak, Budhkedar, Ghuttu, Panwali, and Trijuginarayan. The following notes are on the three interesting bird species seen during the trek.

ORANGE PARROTBILL (*Paradoxornis nipalensis*)

Two pairs were seen near Dhodital one on 30th May and other on 1st June. Both frequented ringal bamboo in wet oak forest around 10,000! The birds kept exclusively to the growth of ringal on steep hillsides. The pair seen on 30th May was collecting nest material by stripping threads from ringal bamboo leaves. The pair became very much agitated by my presence and kept uttering thin chirruping (alarm?) calls. They were undoubtedly nesting nearby but I failed to find a nest owing to the difficulty of the terrain. The pair kept within a few feet of me, giving ample opportunity to confirm the identification. The pair seen on 1st June was associating with white throated Tits (*Aegithalos niveogularis*).

The westernmost limit of distribution of this species is north-eastern Garhwal (Ripley 1982). Dhodital is in extreme west Garhwal. The habitat and breeding of the Garhwal race is unknown and the nesting is not recorded west of Bhutan (Ali & Ripley 1971).

Ringal bamboos seems to be the preferred habitat of this species, on which it is nearly dependant. Unfortunately we noticed large scale cutting of Ringal throughout our trek. If this continues at the present rate, the ringal bamboos, and with it this dainty little parrotbill will disappear from this area in no time. It was very fortunate that we were able to locate the presence of this bird in time, or else it would have disappeared without we being aware of its occurrence in this area. Many more species in the remaining tracts of wet mountain forest of W. Garhwal are facing a similar fate.

BLACKFACED FLYCATCHER-WARBLER (*Abroscopus schisticeps*)

A small group of 5 of these flycatcher-Warblers was seen below Belak (Tehri dist.) in a hunting party, frequenting a lightly wooded patch, at 6000′. The broad yellow eyebrow, black eye band, yellow throat and vent interrupted by white belly were prominent. The hunting party was feeding in medium-sized trees, close to the path. The flycatcher-Warblers were observed over a lengthy period of time and were identified as '*Abroscopus schisticeps*'. This was subsequently confirmed from the specimens in the Society's collection.

According to SYNOPSIS it is not found West of Central Nepal. But the Westernmost limit of these species is an undated record by Lavkumar Khacher who saw it near Guptkashi, at 6500′. Belak is approx. 50 Km West of Guptkashi and the area in between high mountain ranges and steep valleys. This sighting seconds and also extends this flycatcher-Warbler's existence in Garhwal.

Many passerines having distribution from Garhwal eastwards through Nepal, Sikkim, have been split up in geographical races, often having separate race for Garhwal. Thus it is quite possible that this newly discovered population of *Abroscopus schisticeps* is geographically distinct from the C. Nepal population. This point is worth investigating.

PURPLE COCHOA (*Cochoa purpurea*)

A pair of this rare and interesting species was seen near Agoda (Uttarkashi dist.) on 28th May frequenting large moss covered trees, near a stream, in dense humid forest on the way to Dhodital lake. The female was sighted first perched quietly inside the thick foliage. When disturbed it silently flew away and disappeared in the foliage of a tree, and it was immediately joined by the male. In the gloom of the moist forest the male looks very dark with pale lavender crown and pale blue tail tipped with black. Both the birds kept to the foliage and were silent. Fortunately the male obliged us by perching on a sunlit branch where we could observe it more carefully.

Here Stuart Baker's (1924) discription is worth quoting "It is a shy bird and inspite of its brilliant colouring, it is no means' conspicuous until it strikes a patch of sunlight, when it is at once transformed into a most beautiful object. The dark plumage merges well in the canopy of moist forest, and when the male exposes itself to the sunlight, the remarkable transformation is undoubtedly for female attraction. Thus plumage of this bird serves the purpose of female attraction, without making it conspicuous to predators. In most of the species bright colour acquired due to sexual selection often is a disadvantage in terms of survival, i.e. natural selection. This duel purpose plumage seems to be very interesting evolutionary compromise to the conflicting forces of natural and sexual selections. It is also interesting note that the males of the majority of the bright coloured species remain conspicuous even in shade.

Other birds seen in the vicinity were Maroon Oriole (*Oriolus traillii*), Blackcapped sibia (*Heterophasia capistrata*) and small niltava (*Muscicapa macgrigoriae*).

This species has been recorded from Dhanaulty (Hussain & Waltner 1975) as the westernmost record. We observed this species about 80-90 km. north-west of Dhanoulty. This is probably first sighting for north-west Garhwal.

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3, ROCKY HILL,
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16. FEEDING BEHAVIOUR OF SUNBIRDS, *NECTARINIA ZEYLONICA* AND *N. LOTENIA*

I have in my garden in Pondicherry a large shrub of *Hamelia patens*, the flowers of which attract numbers of Purple-rumped sunbirds, (*Nectarinia zeylonica*) and Loten's sunbirds (*N. lotenia*) throughout the year. This year a pair of *N. zeylonica* nested in the garden, successfully rearing two broods in January-February and March. The *N. lotenia* were not seen until April, when the *Hamelia* came into full bloom. All members of the purple-rumped sunbird family vigorously chased away the bigger Loten's sunbirds, but the latter returned again and again to feed. The method of feeding of the two species on the dangling orange-red sprays of flowers is entirely different and worth recording.

Nine uninterrupted feeding sequences were observed for the purple-rumped sunbirds, two each for the parents and five for the young fledglings, which were still soliciting their parents unsuccessfully for food. The birds feed continuously for 1 to 20 secs., then stop to hop about the twigs, wiping their beaks and flicking their wings, before beginning another feeding session. In all 249 secs. (80.78% of total feeding time) were spent perching on the base of the spray and probing with almost the whole beak inside the short orange-red tubes. Fortyseven secs. (19.24% of the total feeding time) were spent hovering, mostly by one of the young birds; the parents hardly hovered at all.

The Loten's sunbirds fed mainly in short bursts of hovering in front of the bunches of flowers, moving in flight from spray to spray, with only the tip of the long bill inside the flowers. In 9 feeding sequences observed 282 secs. (87.27% of the total feeding time) were spent hovering, and 41 secs. (12.73% of total feeding time) perching and probing. It was noticeable that there was hardly any perching in the morning, but that towards late afternoon perching sessions became more frequent. Between feeding sessions the birds hopped about the twigs, beaks open and wings nervously

TABLE 1

DIFFERENCES IN FEEDING BEHAVIOUR BETWEEN *Nectarinia zeylonica* AND *Nectarinia lotenia*

	N. zeylonica	*N. lotenia*
Total feed time observed	296 secs.	323 secs.
% spent hovering	19.24	87.27
% spent perching	80.76	12.73
Time spent continuously hovering	1–6 secs.	2–9 secs.
Average	2.6	3.8
Time spent continuously perching and probing	1–20 secs.	2–8 secs.
Average	7.5	3.7

flicking (much more often than the Purple-rumped sunbirds), uttering a squeaky *tseek* at intervals. They also chased each other feebly when not being attacked by their rivals. The Table 1 summarises differences in feeding behaviour.

There was a *Plumeria rubra* in flower next to the *Hamelia patens,* ignored by the purple-rumped sunbirds. Loten's sunbirds spent a little time perching and probing these flowers, and making holes at the base of the corolla to get at the nectar. They have, therefore, different methods to deal with different flowers. At *Hamelia* however, the differences in feeding behaviour between the species are so marked that it is possible to identify *N. lotenia* by their persistent hovering and moving in flight from one dangling bunch to another, before confirming the identification with binoculars. A male in full breeding plumage, a young male assuming adult plumage, with a broad central black stripe from throat to abdomen, and three or four females/immatures have all shown the same type of behaviour.

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17. CO-OPERATIVE FEEDING OF CHICKS OF THE PURPLE-RUMPED SUNBIRD (*NECTARINIA ZEYLONICA*)

Although two eggs in a nest is the normal clutch of the Purplerumped Sunbird (*Nectarinia zeylonica*), feeding of the chicks in the same nest by two different females does not seem to have been recorded.

Two nests were constructed by different pairs of the Purplerumped Sunbird last summer on Bougainvillaea twigs in the portico of my cottage at Santiniketan, Bolpur, Dist. Birbhum, West Bengal. One of the nests was destroyed in a gale soon after. In early September 1984, it was discovered that two separate females, one lighter coloured than the other, were feeding the two chicks in the surviving nest. This continued for 17 days, when the fledglings flew off the nest. The females fed the chicks almost simultaneously, and one of them sat with the young at night. The single male merely helped bringing the food along with the females, but never approached too close to the nest.

The nest was made up of fibrous material and bright parts of the fruits of some local Asclepiadaceae. It measured about 16 cm long and 6.5 cm broad, with the opening and the porch located in the upper half.

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18. REPEATED VOLUNTARY CAPTIVITY BY A FEMALE MUGGER

The Gharial Research and Conservation Unit at Tikarpara (Satkosia Gorge in Mahanadi River-Orissa) has four mature Muggers (*Crocodylus palustris*) in one of the pools in addition to Gharials (*Gavialis gangeticus*). Both muggers and gharials inhabited the river with comparatively large populations in the Satkosia Gorge. Only a few of the free living muggers and Gharials were left in the gorge before their populations were supplemented by the conservation project.

On 31.1.79 an adult wild female mugger smelt its way to the male housed in the pool and broke through the wire-mesh fence at a weak point. It was named Basanti as it had traced her way guided by smell (Basana = Smell in Oriya) of the male. The very day copulation was noticed, but there was no laying of eggs that year. Though it stayed in the pool during the 1980 breeding season and there was copulation, Basanti did not lay eggs that season also. It escaped from the pool into the river on 4.8.80 the same way as it had come by breaking through the wire-mesh.

On 16.3.81 it again came into the enclosure in the same manner and stayed upto 31.8.82 when it again escaped. During the stay over two breeding seasons it layed 12 eggs in 1981 and 14 eggs in 1982. We got 17 hatchlings (5-1981, 12-1982). On 23.2.83 it again came back to its mate and layed 20 eggs and all the eggs hatched. This time it continued to remain in the pool for three breeding seasons (1983, 1984 & 1985) and layed fertile eggs in all the three seasons. It has again escaped on 16.10.85.

Muggers generally start copulating 10 to 15 days before eggs are laid. Eggs are laid in March and April and hatchlings come out after about 50 to 60 days.

Invariably Basanti has always come to the pool in search of the male immediately before the breeding season and has tried to escape to the wild after it has successfully bred. The remarkable feature of its escape and entrance is that it has never skipped a single breeding season and has sacrificed its freedom for breeding in the enclosure. But sometimes (1979, 1981, 1983, 1984) it has not been possible for it to escape as it might not have been able to locate a weak point in the enclosure. The details of its entry and escape and the seasonwise laying of eggs would corroborate these observations.

First Entrance 31.1.79 First escape 4.8.80
Second Entrance 16.3.81 Second escape 31.8.82
Third Entrance 23.2.83 Third escape 16.10.85.

Season	Eggs laid	Date of hatching	No. of hatchlings
1981	12	—	5
1982	14	15.5.82	12
1983	20	11.5.83	20
1984	18	19.5.84	15
1985	15	9.5.85	12

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DIVISIONAL FOREST OFFICER,
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19. SHELL INJURY IN A FRESHWATER TURTLE *TRIONYX GANGETICUS* (CUVIER)

(*With a text-figure*)

Unlike that of normal specimens, the carapace of a turtle collected in 1979 from Betwa river, Madhya Pradesh was posteriorly incomplete above the tail. The notch was 3.5 cm deep and thus the tail was clearly visible to the out-side (Fig. 1). The turtle measured 42 cm in carapace length.

It is presumed that the notch had appeared as a result of injury to the shell. Although reptiles have 'substantial powers' in healing wounds and regenerating lost parts, in the present case the injury may have been severe due to which regeneration is incomplete.

I thank Dr. L. A. K. Singh for comments on the MS.

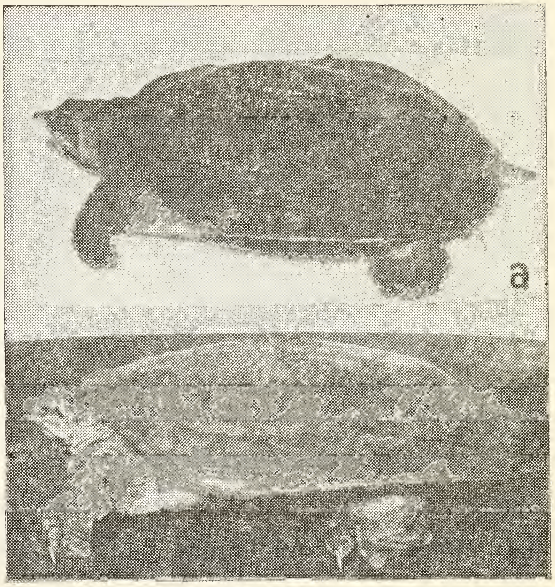

Fig. 1. The soft-shelled freshwater turtle *Trionyx gangeticus* with a notched carapace (a); compaired with an intact carapaced turtle of the same species (b).

National Chambal Sanctuary,
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August 12, 1985.

R. J. RAO

20. ASSOCIATION OF ROCK PYTHON (*PYTHON MOLURUS*) WITH PORCUPINE (*HYSTRIX INDICA*)

During winter Pythons can be seen more often in Keoladeo National Park, Bharatpur. There are several points called 'Python points' in the Park, where they can be seen frequently in and around burrows mostly under *Salvadora* bushes. In one of these points, near the entrance of the burrow, on the freshly excavated soil, spoors and quills of porcupine were seen. This vetted our curiosity to check if pythons and porcupines co-exist.

On 30th November 1985 we saw during the day 4 pythons going into the hole. Observations throughout the night (from 17.15 hrs. to 7.15 hrs.) revealed the following facts.

At about 18.00 hrs a species of microchiropteran bat started coming out of the hole and approximately 50 were seen. They moved in and out frequently up to 3.00 hrs. These were later identified at the Society as *Hipposideros fulvus.*

At 18.20 hrs. a porcupine came out of the hole and went inside again. Again at about 21.00 hrs. two porcupines were seen going out for foraging.

At 22.30 hrs. a python crawled to the mouth of the same hole and remained there up to 7.15 hrs. In between this the porcupines were observed entering the hole at 3.30 hrs, presumably after feeding. Neither the python nor the porcupines showed any aggression or interest in each other.

The python and bat appear to use the same day roost or rest area as the porcupine. This is noteworthy as the porcupine has been recorded as a prey of the python from stomach content analysis (Daniel 1983).

We are very thankful to Dr. V. S. Vijayan, Project Scientist, Hydrobiology Project, BNHS, Bharatpur for encouragement.

JUNIOR FIELD BIOLOGISTS,
BNHS ECOLOGICAL RESEARCH CENTRE,
BHARATPUR-321 001 (RAJASTHAN),
January 21, 1985.

S. BHUPATHY
M. N. HAQUE

REFERENCE

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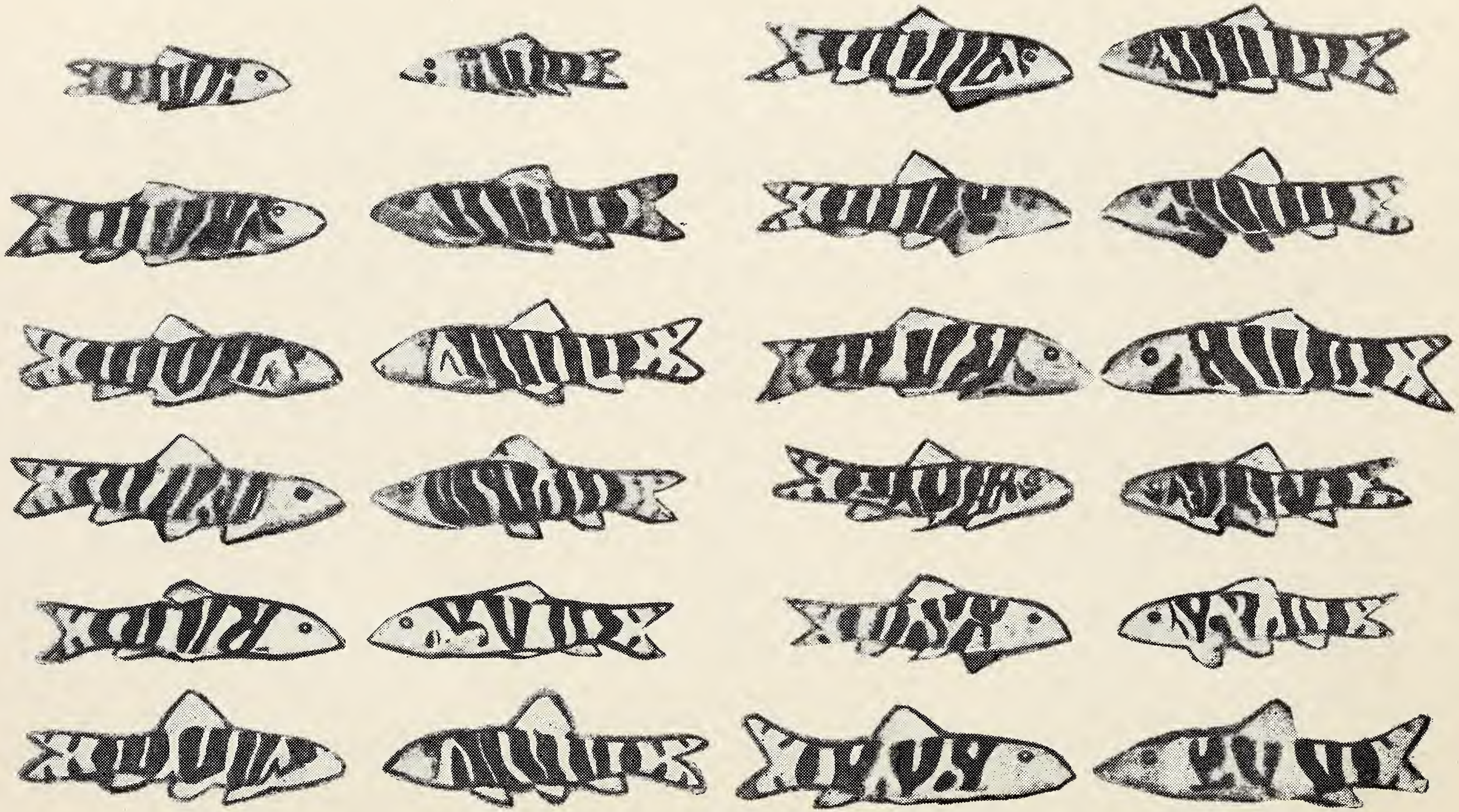
21.. THE GOLDEN TREE SNAKE AT PERIYAR

Whilst on a trip to Periyar Wildlife Reserve at Thekkady, Kerala we went out onto the lake on several occasions. We were traversing in a launch one afternoon, at a particularly wide portion of the lake at about 1.30 p.m. and I was amazed to see a fairly large specimen of the Golden Tree flying snake (*Chrysopelea ornata*) moving vigorously up the wide trunk of a dead tree in the lake. We stopped the launch to watch and make certain of the identification. It was a particularly fine specimen, roughly 2½ ft long, with very beautiful markings. Its presence in the middle of the lake was of interest for on either side of us there was at least 100 yards of water to the nearest land. One wonders if the snake had swum to the dead tree or glided from the evergreen canopy on one side of the lake. Since it glides using its concave and flattened belly as a parachute I would have thought 100-180 yards would have been quite beyond its capacity. However would it then be possible, if it alighted on water of on another petrified tree for it to swim to the remaining distance? Since this snake is rarely seen in the Indian subcontinent I was delighted to have an opportunity to watch it for some time in its natural habitat and at such close quarters.

J. Bombay nat. Hist. Soc. *83*
Sane & Chhapgar: *Botia dario*

Plate I



Different colour pattern variations in *Botia dario*.

PIPPA MUKHERJEE

KODAIKANAL SCHOOL,
KODAIKANAL-624 101,
SOUTH INDIA,
November 19, 1985.

[Snakes identified as of this species have been noted (*JBNHS* 12 p. 589) to glide from a tree on one side of the road to a lower one on the other side, and another note (*JBNHS* 56 p. 640) tells of one that travelled similarly for an estimated distance of 55 yards from tree to tree down a hill side. — Editors.]

22. VARIATIONS OF COLOUR PATTERN IN THE NECKTIE LOACH, *BOTIA DARIO* (HAM.-BUCH.)

(*With a plate*)

The necktie loach, *Botia dario,* was first described by Hamilton-Buchanan in 1822, who named it *Cobitis dario.* Its normal coloration is a series of 7-8 obliquely vertical bands descending from back to abdomen, and sloping slightly backward. On each lobe of the caudal fin there are three or more thin black bands. As with all species of *Botia,* the scales are very small and indistinct. Its fin-ray count is:-
D. 3/9-10; V. 1/7; P. 14; A. 2/5-6; C. 19.

An allied species, *Botia geto,* also first described by Hamilton-Buchanan in 1822, has often been confused with *B. dario.* While he considered it to be a distinct species, Gunther (1868, *Cat. Fish Brit. Mus.* vii: 366) regarded it as a young form of *B. dario.* Day (1872) considered the former as a doubtful synonym of the latter, but later (in 1878 and 1889) thought them to be two distinct species. Hora (1922) included Day's references of 1878 and 1889 to *B. geto* in the synonymy of *Botia birdi* Chaudhuri (1909). Later (in 1932), Hora considered that two of the specimens referred to by Day as *B. geto* were young forms of *B. dario,* while one of Day's specimens from Sind named by him (Day) as *B. geto* was named by Hora as a new species, *B. dayi.* (The specimens collected by Dr. B. S. Lamba from Mahableshwar, and wrongly identified as *B. dayi* by Babu Rao & Yazdani, are actually *Botia striata*).

While the caudal peduncle in *B. dario* tapers posteriorly, in *B. dayi* it is squarish. While in *B. dario,* the eyes are situated almost in the posterior half of the head, in *B. geto* they are not situated wholly in the posterior half of the head. In *B. dario* the eyes are moderately large, their diameter being contained 3 times in the length of the snout, while in *B. birdi* they are small, their diameter being contained 4 to 4.5 times in the length of the snout.

Botia dario has been collected from Cachar, Meghalaya, Northern Bengal and Bangladesh. In the present collection from Silchar, although the predominant pattern of obliquely vertical, parallel bands are easily distinguishable, many specimens exhibit deviations from this pattern. In some cases two bands coalesce at their lower extremities, in others they join in the middle to form an H, while a few have some of the bands in the shape of the letter Y, which is characteristic of *Botia lohachata.*

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BOMBAY-400 001.

S. R. SANE

E-31, CUSROW BAUG,
COLABA CAUSEWAY,
BOMBAY-400 039,
April 23, 1986.

B. F. CHHAPGAR

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23. 'BANAS' FISHING IN BEELS OF ASSAM

(*With a text-figure*)

'Banas' fishing was introduced in Dhir beel, district Dhubri, Assam, by Bihari fishermen in late sixties and the method met with tremendous success which led the other beel fishermen adopting this technique. Dhir beel is connected to river Brahmaputra by a channel. The channel plays a pivotal role during monsoon, when, with the current, adults and juveniles of various species enter the beel for breeding, feeding, temporary migration, etc. With the waning monsoon, the current starts receding towards the river and many species undertake their return journey and at this stage the 'Banas' fishing commences.

METHOD

(a) *Selection of site*: The channel connecting the beel to the river is *c.* 3.5 Km, in length. During winter and premonsoon periods the channel (Fig. 1) maintains its contour while during monsoon the entire surrounding area is inundated and the channel also loses its shape, leaving a narrow constriction at the point where the National highway 31 crosses the channel. It is here that the 'Banas' are erected and the reasons for selecting the site are:

(a) N.H. 31 runs on the south bank.
(2) On the north-west small hillocks prevent spreading of water.
(3) Construction of bridge over the N.H. has narrowed the width of the channel.
(4) Proximity of N.H. facilitates transport and marketing of fishes.

(b) *Preparation and erection of Banas*: Locally available giant variety of bamboo are cut into thin strips and closely woven with coir

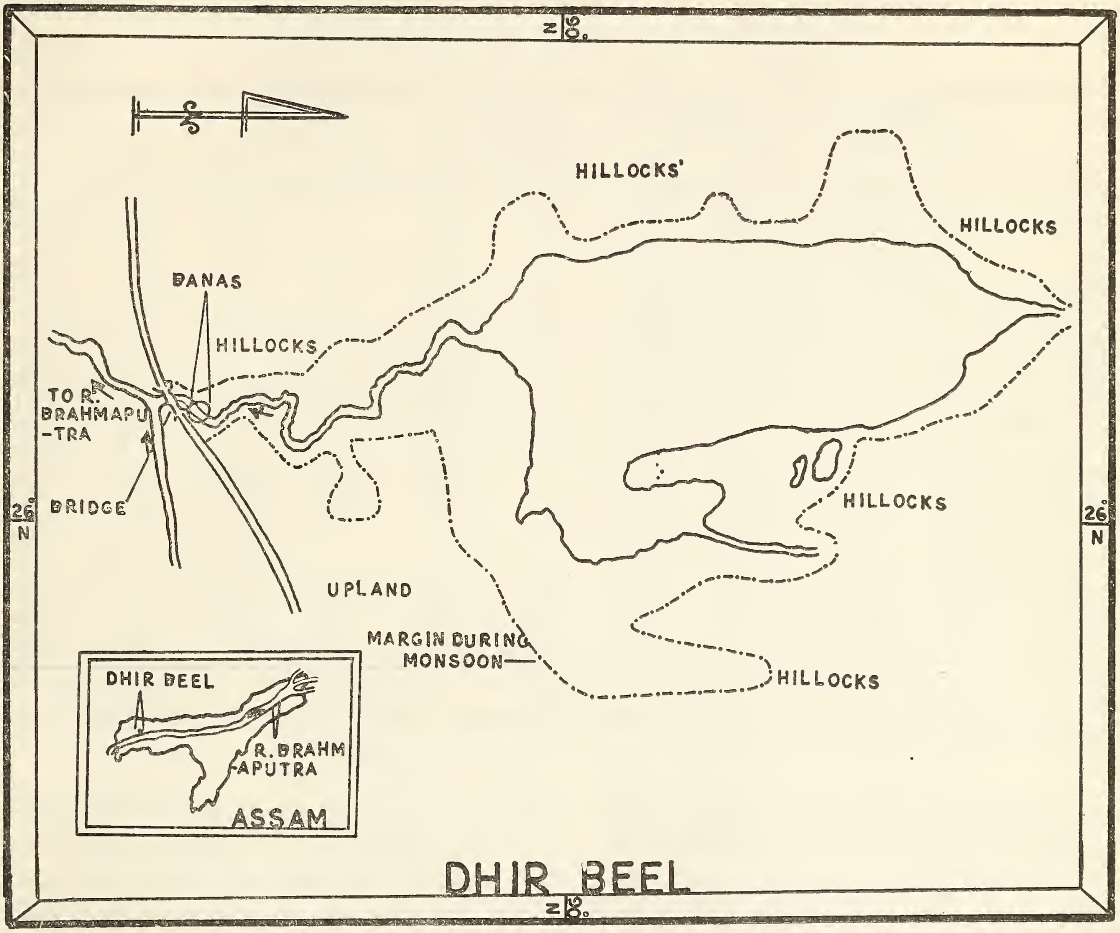
90°N
HILLOCKS'
HILLOCKS
BANAS
HILLOCKS
TO R. BRAHMAPU-TRA
BRIDGE
26° N
26° N
UPLAND
MARGIN DURING MONSOON
HILLOCKS
HILLOCKS
DHIR BEEL
R. BRAHMAPUTRA
ASSAM
DHIR BEEL
90°N

Fig. 1.

rope into screens of 2-3 m length and *c.* 6 m width. Besides standing long immersion in water with no change in shape, the screen permits as low an interspace as 0.5-1.0 cm between the strips. The screens of 'Banas' are fixed across the channel, bank to bank, with the help of wooden stakes. The submerged portion of the *banas* are further lined inside, by gill nets which are folded to trap fishes in their attempt to jump over the *banas*. In the centre of the channel a 3-5 m wide gap is left. A dip net is installed in this gap. 8-10 metres behind this placement, another obstruction of *banas* is arranged from bank to bank giving a similar V-shape in the centre. In this V a gill net is placed which is tied with bamboo sticks in the broader end of the V, and at the narrow end the net is tied to poles. The enclosure is also known as *'Bharal'* or the store-house. One or two dip nets are also placed in between the two bamboo periphery.

(c) *Operation*: The fixing of *banas* starts

TABLE 1

SPECIES-WISE DISTRIBUTION OF FISH CATCH (IN KG.)

Fishes	August		September		October		November			
	Total	%	Total	%	Total	%	Total	%	Total	%
L. rohita	102	21.07	56	1.09	3	0.02	2	0.09	163	0.92
*L. calbasu**	—	—	272	0.17	182	1.51	1	0.04	455	2.58
L. bata	—	—	20	0.67	21	0.17	—	—	41	0.24
C. catla	—	—	166	5.60	41	0.34	—	—	207	1.17
C. mrigala	—	—	2	0.06	—	—	—	—	2	0.01
C. reba	7	1.45	67	2.26	36	0.30	5	0.23	115	0.65
*L. gonius**	—	—	—	—	3	0.02	—	—	3	0.01
W. attu	14	2.89	149	5.02	45	0.37	6	0.29	214	1.21
M. seenghala	6	1.23	1	0.03	3	0.02	—	—	10	0.06
R. rita	—	—	1	0.03	—	—	—	—	1	0.003
H. ilisha	83	17.14	87	2.93	5	0.04	3	0.14	178	1.00
G. chapra	16	3.30	1261	42.51	11463	95.30	2114	98.37	14854	84.27
E. vacha	89	18.39	783	26.40	2	0.01	—	—	874	4.96
N. notopterus	7	1.45	11	0.37	—	—	—	—	18	0.10
N. chitala	11	2.27	28	0.94	26	0.27	—	—	65	0.37
Miscellaneous	69	14.25	41	1.38	130	1.08	18	0.84	258	1.46
Live fishes	80	16.53	21	0.70	68	0.56	—	—	169	0.96
Total	484		2966		12028		2149		17627	

* The catch figures pertain to the year 1982.
October November

with the decline of the monsoon and the fishing starts from the second week of August and lasts till mid November. The fishes are caught in three ways. The maximum catch is landed by the dip nets, which accounts for *Eutropiichthys vacha, Gudusia chapra* and fingerlings of Indian major carps and hilsa. Four to five men position themselves at the anterior end of the V and at intervals lift the gill net with the help of already attached bamboo poles. Thirdly, fishes attempting to jump the *banas* are caught in the pockets of the net lining the submerged portion of the *banas*. The last two methods yield big carps, hilsa, featherbacks and catfishes. The water level at the site fluctuates from a maximum of 440 cm in September to 260 cm in November.

TABLE 2

SIZE RANGE OF COMMERCIALLY IMPORTANT SPECIES CAUGHT IN THE *Banas*

Species	Length (mm)	Weight (gm)
L. rohita	330-590	450-1050
C. catla	390-500	890-11980
L. calbasu	400-510	800-1900
W. attu	340-735	170-1700
H. ilisha	Fry-510	...-1450
G. chapra	Fry-285	...-25
E. vacha	230-256	100-130

CATCH COMPOSITION

Out of 53,676 Kg of fish caught during the period August to November 1982 by all gears in the beel, *banas* contributed 17,627 Kg, i.e.

32.82%. *G. chapra* (84.27%) dominated the catch followed by *E. vacha* (4.96%) and *L. calbasu* (2.58%). Besides this, fingerlings of Indian major carps and hilsa are also caught in plenty. Table 1 gives the species distribution in the catch during the months and table 2 the ranges of length and weight of the important species.

Cost of Operation

The cost of operation of *banas* fishing and the income derived from the sale of fishes have been computed to ascertain the economic feasibility of this method. The expenditure incurred on material, etc., and the returns from fish sale are presented in tables 3 & 4.

Table 3

Expenditure incurred on installation of *Banas* and other infrastructure

S. No.	Items	Expenditure	Remarks
1	Fishermen's hut	Rs. 2000.00	
2	Cost of bamboo*	Rs. 3000.00	500 Nos. @ Rs. 6/- each
3	Cost of coir	Rs. 1000.00	
4	Cost of pole	Rs. 250.00	
5	Cost of dip net, etc.	Rs. 1000.00	
6	Miscellaneous	Rs. 750.00	

* The bamboos used in 'Banas' can be used repeatedly with marginal depreciation.

Table 4

Selling rate of fishes and net income from *Banas* fishing

Species	Wt. (Kg) × Price/Kg. (Rs.)	Total (Rs.)
G. chapra	14854 × 3.00	44562.00
E. vacha	874 × 8.00	6992.00
L. rohita	163 × 15.00	2145.00
L. calbasu	455 × 8.00	3640.00
Others	1281 × 3.00	3843.00
	Total	78809.00

Net income = Rs. 78809.00 − 8000.00 = Rs. 70,809.00

Discussion

Fishing methods in beels are diverse and some of them are unique. Common gear such as cast nets, gill nets, dip nets and traps are in vogue but certain beels offer ample scope to practise 'Katal' fishing (Yadava *et al.* 1981) and *'Banas'* fishing effectively.

The *banas* are fixed barriers, erected across the channel to prevent return of fishes from the beel to the river along with the receding waters. It is considered one of the major fishing methods where the beel has a connection with the river. *G. chapra, E. vacha,* adults and juveniles of *H. ilisha* entering the beel along with the floods, tend to return with the receding waters and are chiefly caught. It acts as an obstruction for the commercially important varieties like *L. rohita, C. catla, C. mrigala, L. gonius* and featherbacks migrating back to the river. These fishes are later on harvested in 'Katal' fishing (op. cit.). If the barriers are not erected it is likely that a sizeable number would return to the river.

Banas fishing has some resemblance to 'Roak' fishing of River Yamuna (Wishard 1976). However, *banas* are in vogue in post-monsoon months, whereas *roak* is operated during pre-monsoon and monsoon months. Unlike *roak* fishing this method does not have much deleterious effect on the fisheries except the wanton killing of juveniles of Indian major carps and other commercially important species. The *banas* can be more judiciously exploited by:

(1) The fingerlings of commercially important varieties caught in the *banas* can be restocked in the beel proper or a few pockets in the beel can be suitably barricaded to form temporary nurseries and rearing spaces where

these fingerlings can be housed for better survival. They can be released later in the beel.

(2) Income can be further enhanced by organizing better marketing facilities and transportation at the site. The present selling rate of the fish is too little as compared with the rates in the neighbouring areas.

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24. A DRY SEASON AGGREGATION OF DANAINE BUTTERFLIES IN CORBETT NATIONAL PARK (LEPIDOPTERA: NYMPHALIDAE: DANAINAE)

In the beginning of June, 1985 I came across a large aggregation of four species of Danaine butterflies in Corbett National Park, U.P., 600 m, India. There are several records of large aggregations of Danaine butterflies in the literature (*see* Ackery & Vane-Wright 1984 for an excellent review of all aspects of these interesting butterflies). Two purposes may be involved. First, the aggregation may be at a source for pyrrolizidine alkaloids, compounds that are necessary for sexual success of the males, through the activation of pheromones necessary for courtship. Such assemblies are almost wholly male. At a patch of *Ageratum conyzoides* (Compositae) in the Hauz Khas Rose Garden of South Delhi I did a random sample along a watering canal densely bordered by this plant. Among 123 specimens collected at random only two were females, despite the fact that the plant should be an excellent nectar source. Second, the aggregations may be roosts where adult butterflies pass winters, dry seasons, or other climatic vagaries when breeding is impossible. According to Ackery & Vane-Wright (1984) such aggregations are 'well known' but poorly documented. Many variables are involved including temperature, humidity, wind conditions, nectar and water resources, and the availability of roosting sites at night'. In such aggregations both sexes will be present.

The site, near the lovely Gairal Forest Rest House, was in dense Sal forest (*Shorea robusta*) with a minimal understory vegetation. The main characteristic of the site — at a very dry time of the year — was a permanent water seepage covering an area of 50 by 100 square metres. In addition there were many bare bushes which provided roosting places for the butterflies at night. Both sexes of the species in question came avidly to drink from the seepages in the forest floor. Two species of Oakblue butterflies (genus *Arhopala*) also came to drink in numbers, but otherwise butterflies were almost absent.

I did a number of transect walks through the site, catching at random any specimen within reach. Towards the end of the sampling, the three rarer species were sampled purposively, to get a better grip on their sex ratio. A full population estimate, in a population ideal for mark-recapture studies, was not possible for reasons of time. However, it may be estimated that the sampling included less than one in twenty or thirty of the actual population. This conservative estimate is used in Table 1 below, suitably adjusted for the purposive sampling of the three rarer species.

It will be seen from the table that sex ratio is quite normal, and that four fifths of all specimens referred to *Euploea core*, a species which is known to have winter roosts in Queensland.

Danaines are butterflies with strong and persistent sexual display. Males of *Euploea core*, especially, are often seen patrolling a limited space with the pheromone dispensing abdominal hair pencils extended, even when no females are present. In Delhi I have observed one male displaying uninterruptedly for more than fifteen minutes, flying above a patch of ground less than 100 square metres. Danaines also pair readily and stay in copula for long. No example of sexual display or sexual interaction was seen during four hours of observation over two days.

The abdomens of most specimens were strongly distended, especially in the females. Dissection of two females, however, showed no trace of eggs, but plentiful reserves of fatty tissues. The specimens appeared to be in a state of sexual diapause.

There can be little doubt as to what was involved. The aggregation was a dry season roost of specimens surviving the extreme dry season and/or the extreme hot season in a state of sexual diapause. In the Corbett the dry and hot season fall at the same time, and is preceded by a winter, when breeding oppor-

TABLE 1

COMPOSITION, SEX RATIO AND STRUCTURE OF THE DANAINE BUTTERFLY AGGREGATION SAMPLED AT CORBETT NATIONAL PARK

Species	Male	Female	Total	Population estimate*	Per cent of population
Euploea core Cramer	28	28	56	1120-1620	81
Danaus genutia Cramer	6	7	13	200-300	15
Danaus chrysippus L.	2	—	2	20-30	1
Tirumala limniace Cramer	2	2	4	40-60	3
Total	38	37	75	1380-2010	100

* These figures match the general visual image but is lower than an alternative estimate based on population density. My guess was that one butterfly was present per square metre in the area totalling 5000 m^2, or slightly less.

tunities may be sub-optimal. I suspect the larvae of the species in question cannot survive in June when temperatures in the shade regularly exceeds 40° Centigrade. The site determinants are obviously the simultaneous presence of shade and water, as well as perhaps nectar sources. Very few Danaines were seen in other parts of the park, except in conjunction with similar, but smaller, water seepages. Doubtless the population of such a site builds up gradually though the recruitment of passing butterflies and with very little loss of the existing stock. It would be extremely interesting if a resident of the National Park could monitor the build up and variation of such a roost during the period of an entire year. Probably the roost will dissolve with the onset of the monsoon in late June.

Towards nightfall the butterflies perch on naked twigs of understory bushes, usually about a metre above the ground. They invariably settle in little clusters of two to six specimens, a trait well known in the subfamily, probably related to the fact that the species are aposematic.

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Reference

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25. *AGERATUM CONYZOIDES* (COMPOSITAE) INDIRECTLY CONFIRMED AS A SOURCE FOR PYRROLIZIDINE ALKALOIDS

In their excellent review of Danaine butterflies, Ackery & Vane-Wright (1984: Table 2) include the pan-tropical weed *Ageratum conyzoides* as a probable source of pyrrolizidine alkaloids. These compounds are an essential feature in the life of adult Danaine butterflies (in India the genera *Danaus, Euploea, Parantica, Tirumala* and perhaps *Idea*), since the pheromones necessary for successful courtship will not be developed in their absence. In more purple prose male Danaines cannot activate their love dust before ingesting pyrrolizidine alkaloids from a suitable source. However, the plant in question has not been biochemically assayed in this respect.

During intermittent butterfly studies in India, and especially New Delhi, between April 1984 and June 1985, I have observed large numbers of male Danaine butterflies coming to the blue flowers of *Ageratum conyzoides*, a weed associated with moisture. Although the flowers appear most suitable as an ordinary nectar source, Danaine specimens collected from the flower are almost invariably male. The only common Danaine in New Delhi is *Danaus chrysippus* Linné, the Plain Tiger, which on a number of occasions I have sampled on *Ageratum conyzoides*:

TABLE 1

RANDOM SAMPLES OF *Danaus chrysippus* COLLECTED FROM THE FLOWERS OF *Ageratum conyzoides* IN NEW DELHI

Place and date	males	females
Govt. Sunder Nursery, 27.x.1984	100+	0
Govt. Sunder Nursery, 29.x.1984	38	1
Govt. Sunder Nursery, 11.x.1984	52	0
Hauz Khas Rose Gdn., 26.iii.1985	17	0
Hauz Khas Rose Gdn., 10.iv.1985	123	2
Total	330+	3

Both sexes of this butterfly normally come to flowers. I have observed smaller numbers of *Danaus genutia* Cramer, *Tirumala limniace* Cramer and *Euploea core* Cramer on the same plant, nearly all males.

However, in addition to coming to the flowers of the plant, large assemblages of male Danaids may also be found on withered patches of the plant, such as where a sewage drain has dried out. When clumps of *Ageratum* have been mown down, Danaines will be attracted to the cut stems. Sometimes they are very partial to upturned roots when an area with *Ageratum* has been plowed. The strongly sex-skewed observations and the fact that males are also attracted to dried plants leave little doubt that the plant is a pyrrolizidine alkaloid source. My observations in Delhi indicate that it is crucial for the Danaine populations of that city, and especially to *Danaus chrysippus*, though there are other sources available in the form of *Crotalaria* and *Heliotropium**. Both *Danaus chrysippus* and *Ageratum conyzoides* are widespread, adventive, almost synanthropic species. In the Old World their area of distribution is practically the same and this is probably not by chance.

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* [See also "Danaid butterflies attracted to *Heliotropium indicum* (Boraginaceae), an alkaloid containing plant." By S. R. Amladi, published in *J. Bombay nat. Hist. Soc.* 72(2): 585-587 — Editors.]

26. OCCURRENCE OF *PSYCHE* SCHRANK (LEPIDOPTERA: PSYCHIDAE) ON LITCHI (*LITCHI CHINENSIS* SON.) IN THE PLAINS OF U.P.

Psyche vitrea Hampson was reported as a pest of mango in the plains of India (Lefroy 1909). We have observed the incidence of *Psyche* sp. on the leaves and young fruits of Litchi at the litchi block of the Horticultural Research Institute, Saharanpur (U.P.) during

April-May of 1981, 1982, 1983 and 1984. The occurrence of this pest on *Litchi chinensis* Son. constitutes a new record.

The males are small delicate moths with dusky wings and markedly pectinate antennae. The female is found, inside the creamy conical and extremely tough case, opening at both the ends, as a vermiform sac without internal structures but filled with eggs and having a genital opening below. The female is fertilized due to the penetration of the long protrusible abdomen of the male into the female case though its narrow end. The eggs are laid in the case. The female gradually shrinks up as the eggs fill the lower portion of the case. The larvae hatch, emerge from the mother's case and make their own case. The case is firmly held by the hind end of the body. The larva is a typical caterpillar with three pairs of thoracic legs and can extrude the thorax for the purpose of locomotion. It scrapes and eats away the green part of the leaves and young fruits, consequently resulting in less yield. The caterpillars, to form the male moths, pupate with the head downwards. Each of the pupae wriggles half through the lower wider open end of its case and finally a male moth emerges. The larvae, which develop into the females, moult, pass through a period of rest and become the bags of eggs inside their respective cases.

We thank Dr. S. K. Ghosh of the Zoological Survey of India for the identification of the insect.

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REFERENCE

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27. TORTOISE BEETLE — *CASSIDA CIRCUMDATA* HERBST (CHRYSOMELIDAE: CASSIDINAE) AS A BIOLOGICAL CONTROL ON THE GROWTH *IPOMOEA REPTANS* IN KEOLADEO NATIONAL PARK, BHARATPUR

Cassida circumdata is a chrysomelid beetle recently recorded from the Keoladeo Ghana National Park. The larvae voraciously feed on *Ipomoea reptans* (Linn.) Poir (Syn. *Ipomoea aquatica*); Family: Convulvulaceae (Maheshwari 1963), a plant forming about 25% of the aquatic vegetation of the park. *I. reptans* is an economically important plant (Subramanyan 1974). Some birds like purple moorhen, pheasant-tailed Jacana and bronze-winged Jacana use this plant as nesting material in the sanctuary.

I. reptans grow very fast in summer (March-April) producing large fresh green leaves. During this period the appearance of *C. circumdata* was noticed every year. These insects lay eggs on the leaves. The larvae feed on the leaves and tender part of the stem and completely destroy the parts of the plant above water level. By the onset of winter the beetles disappear from *I. reptans*. In winter *I. reptans* remains in a dormant stage without leaves. The tortoise beetle *C. circumdata* hibernates in winter on terrestrial plants especially on *Salvadora persica*. It has been reported from South India that these insects are pests on *I. carnea* and are found throughout the year with a peak in May (Janarthan and Sivagami 1963).

I. reptans grows rapidly and can spread throughout the area within a short period. But the larvae of tortoise beetle which are exclusively dependant on *I. reptans* may play an effective role in controlling the growth.

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28. SOME NOTES ON THE DISTRIBUTION, NATURE OF HOSTS OF THE PARASITE *DENDROPHTHOE FALCATA* (L.F.) ETTINGS. IN THE POINT CALIMERE WILDLIFE SANCTUARY

Dendrophthoe falcata (L.f.) Ettings. *Loranthus longiflorus* Desr. (Fam. Loranthaceae) is a destructive semi-parasite on a large number of species of plants and is pollinated by birds (*Nectarinia* sp.). The majority of seeds are dispersed by another group of birds the flower peckers (*Dicaeum* sp.) which feed mainly on Fruits of Loranthus plants (Kannan, P. 1966, Priya Davidar 1985).

B. Singh (1962) listed 319 host species from all over India. Additions to this list have been made from different parts of the country by Chavan & Oza (1963), Srivastava (1963), Sambandam (1966), Gosh (1969). A survey at the Point Calimere Wildlife Sanctuary (An area of 5663 hectares), Tamil Nadu, revealed the presence of 29 host species in the Sanctuary. From a perusal of the literature on host plants of *Dendrophthoe falcata* it is noted that *Cissus vitiginea* L. (Fam. Vitaceae) (Shown by an asterisk in Table 1) is not recorded as a host from South India. Hence it can be added as an additional host species to *Dendrophthoe falcata*. The nature of infection (severe, moderate or light) and distribution of host (common or rare) were also recorded (see Table 1). Monocotyledons do not have this parasitic infection and the parasite prefers trees rather than shrubs or herbs, i.e. among the 29 hosts recorded 25 are trees. The reason (Fischer 1926) being that Loranthaceae seeds are distributed mainly by birds it is to be expected that trees are more likely to receive them than shrubs. Introduced plants like *Albizzia lebbeck* and *Pithecolobium dulce* were more prone to the attack of this parasite. Certain symptoms like yellow coloration of leaves, formation of small burns on stems which ultimately leads

TABLE 1

LIST OF HOST PLANTS, NATURE OF INFECTION, DISTRIBUTION OF HOSTS AND ECONOMIC IMPORTANCE

S. No.	Host	Nature of Infection	Distribution of Host	Economic use
1.	****Albizzia lebbeck*	S	R	Timber
2.	*Cassia fistula*	S	C	Wood
3.	*Cassia marginata*	M	C	Timber
4.	*Casuarina equisetifolia*	S	R	Fuel wood
5.	*Carissa spinarum*	L	C	Fruit
6.	**Cissus vitiginea*	L	C	Medicinal
7.	*Crataeva religiosa*	S	C	Religious
8.	*Cordia obliqua*	M	R	Fruits, wood
9.	*Dichrostachys cinerea*	L	C	Fuel wood
10.	*Ficus benghalensis*	L	R	Fuel wood
11.	*Ficus religiosa*	L	R	Religious
12.	*Gymnosporia emarginata*	M	R	Wood
13.	*Gmelina asiatica*	S	C	Medicinal
14.	****Hemicyclia sepiaria*	L	R	Fuel wood
15.	*Ixora parviflora*	L	R	Fuel wood
16.	****Lepisanthes tetraphylla*	L	R	Timber
17.	****Maba buxifolia*	L	C	Fuel wood
18.	****Manilkara hexandra*	S	C	Fruits
19.	*Memecylon umbellatum*	L	C	Fuel wood
20.	*Odina wodier*	L	R	Timber
21.	*Pongamia glabra*	M	C	Wood
22.	*Prosopis juliflora*	M	C	Fuel wood
23.	*Pithecolobium dulce*	S	R	Timber
24.	****Plectronia parviflora*	M	C	Wood
25.	*Randia dumetorum*	M	C	Fuel wood
26.	*Salvadora persica*	L	C	Fruits
27.	*Scutia myrtina*	L	C	Fruits
28.	****Thespesia populnea*	M	R	Wood
29.	*Zyzyphus oenoplia*	M	R	Fruits

Note: Nature of Infection
S — Severe
M — Moderate
L — Light

Distribution of Host
C — Common
R — Rare

to the drying of that particular branch were seen in affected species.

Double parasitism:

Several cases of double parasitism (Saxena 1971) (one species being parasitic on another species of the same or allied genera) were also recorded. During the study it was noticed that *Viscum capitellatum* was seen parasitising *Dendrophthoe falcata* which in turn was a parasite on certain species of plants (shown in Table 1 by two asterisk marks).

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29. *ASPLENIUM CAPILLIPES* MAKINO (ASPLENIACEAE) — A SINO-JAPANESE FERN IN THE WESTERN HIMALAYA

(*With four text-figures*)

During the course of a Botanical excursion, undertaken in connection with the preparation of an, 'Illustrated fern flora of W. Himalaya' by one of us (SPK), an *Asplenium* was gathered from Yamunotri hills. This fern was found to be distinct from all known W. Himalayan species of this genus, and Prof. T. Reichstein (Basal, Switzerland) confirmed the identity of the fern as *A. capillipes* Makino. This fern of China and Japan is probably rather rare in India. It is unrecorded in Himalayan fern literature and has also not been mentioned from Tibet (in Flora Xizangica 1983), except H. Ito (in Hara 1971) from Bhutan. The present record is the first authentic report for this fern from India. A detailed description of the species is presented as it seems to be little known to Indian Pteridologists.

Asplenium capillipes Mak., Bot. Mag. Tokyo 17: 77 (1903). (Figs. 1-3).

Rhizome short; erect; apex scaly; scales dark-brown, subulate-lanceolate, apex acuminate, margin sparsely fimbriate with a few dentate projections or almost entire. Stipes (0.5-) 2.4-4.0 cm long, almost as long as the lamina; dark-green; thin, fragile; scaly at extreme base rest sparsely so, scales as on rhizome apex; rhachis usually with a vegetative bud, the position of which is variable, i.e. either at the base of the first or second pair of pinnae

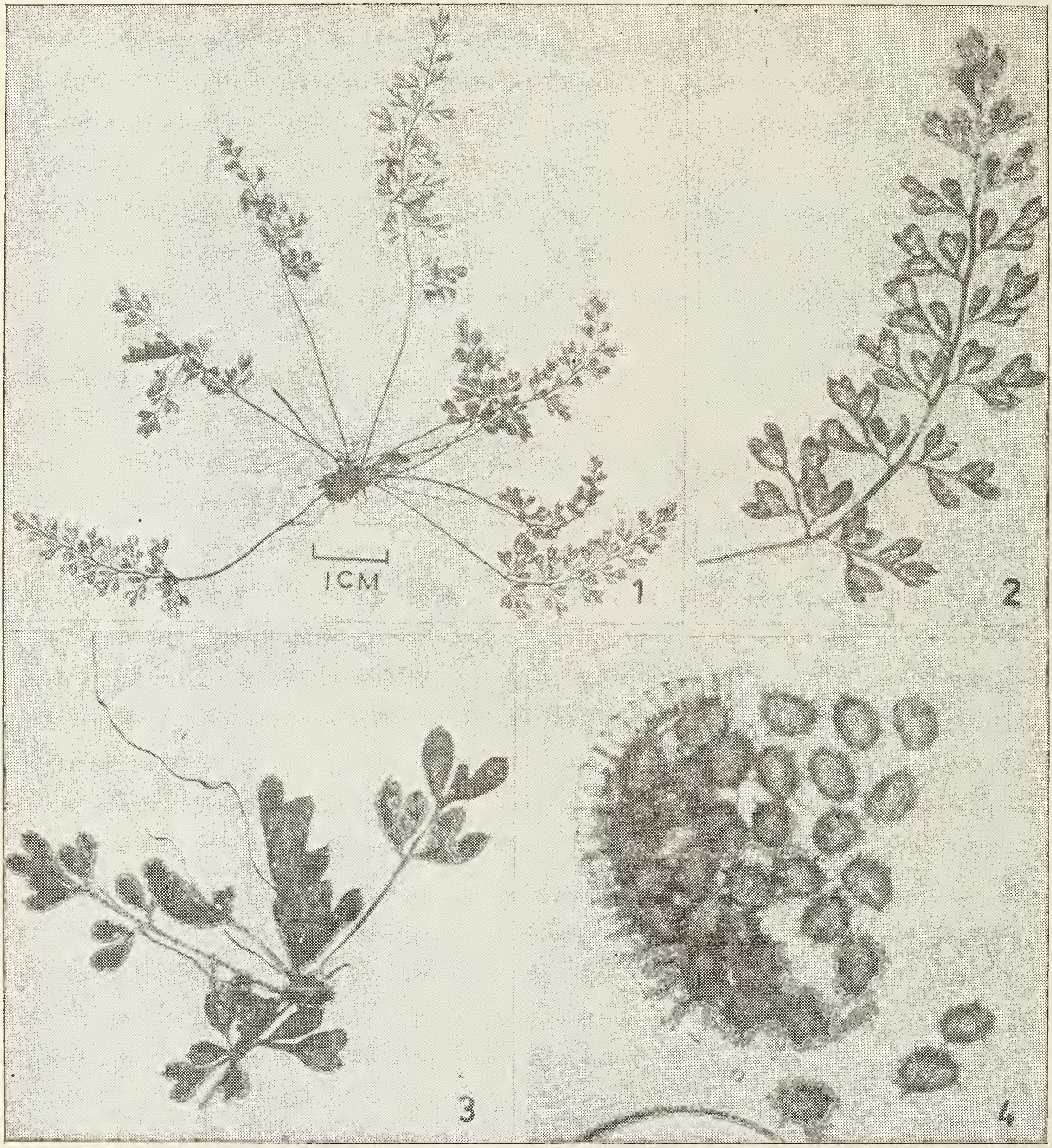

Fig. 1. Entire plant of *Asplenium capillipes* — from Yamunotri hills; Fig. 2. A Single frond (× *c*. 3); Fig. 3. A vegetative bud (× *c*. 3.5); Fig. 4. A sporangium with 32 spores (× *c*. 180).

or even subterminal. Lamina 2(–3)– pinnate, (0.5–) 2.5-3.5 cm long, (0.3–) 1.0-1.5 cm broad, broadest at base; narrowly triangular lanceolate; texture not thick, subcoriaceous; glabrous; upper surface dark grey-green; pinnae up to 7 pairs, 0.5-0.7 cm long, 0.3-0.5 cm broad; alternate; short petiolate; ovate; margin deeply pinnate; pinnules 3-5 pairs in well developed pinnae, 0.2-0.3 cm long, 0.1-0.15 cm broad; shortly petiolate; lanceolate; base cuneate; apex acute ending in a short dentate projection; margin entire or shallowly or deeply lobed at the apex (each lobe ending in short sharp tooth); veins free, simple or forked; 1 per pinnule lobe; glabrous. Sori indusiate; 0.1-0.2 cm long; 1 per pinnule; indusia membraneous, margin ± entire. Spores dark-brown, 45.5–52.5×70.0×84.0. μm; perinate, perine broad.

Chromosome numbers: diploid n=36 (Mitui 1970). Only 32 spores per sporangium (Fig. 4).

The size of the spores is larger than in other members of the *Asplenium varians* complex, but are comparable with *A. aitchisonii* (an octoploid). It would be interesting to study the ontogeny of the sporangium to determine the cause for the low spore out-put per sporangium, since normally 64 spores per sporangium are produced in sexual leptosporangiate ferns. A study of the root tip mitosis is desirable to know the nature of reproduction of this fern. Perhaps lysis of 50% of the spore mother cells is responsible for 32 spores per sporangium.

Distribution: Found growing on a shaded humid rock at *c.* 2,700 m altitude. This is the only record of this fern from the W. Himalaya.

UTTAR PRADESH: Uttarkashi, Yamunotri (*c.* 8 Km from Hanuman Chatti; *c.* 1 Km from Jankibai Chatti, towards Yamunotri; 31.0°N Lat., 78.5°E Long.).

Asplenium capillipes is a member of the *A. varians* complex which in the W. Himalaya consists of at least 7 species, *viz. A. varians* Hook. et Grev. with two cytotypes, a diploid and a tetraploid (this diploid is different from *A. subvarians* Ching, also a diploid from China, and is being given a distinct name, Sleep and Reichstein 1984); *A. sarelli* Hook., *A. tenuifolium* D. Don. To this list was added *A. aitchisonii* by Fraser-Jenkins and Reichstein (1982). Khullar *et al.* (1983) reported the Chinese fern *A. nesii* from Deoban (Chakrata hills).

Asplenium capillipes is easily separable from all members of the *A. varians* complex in having a very thin dark-green to brown stipe and with small vegetative buds on rhachis (also present in *A. tenuifolium*). Most species of the *A. varians* complex have a stramineous stipe with a dark-brown base. From *A. tenuifolium* the present species (*A. capillipes*) can be separated as follows: *A. tenuifolium* is a large robust fern 15-25 (–50) cm long, 6-10 cm broad; stipe stramineous with a dark-brown base, lowest pair of the pinnae smaller than the pair above. *A. capillipes* has small, delicate fronds, 5-7 cm long, 1-2 cm broad, lowest pair of pinnae as long as the pair above or the largest. In *A. tenuifolium* there are often 2 or 3 buds which arise in the groove at or close to the junction of the pinnae-rhachis and first acroscopic pinnule (Sledge 1965). In *A. capillipes* the small vegetative buds are on the rhachis and in varying positions. Both species are diploid with n=36, but in *A. capillipes* only 32 spores per sporangium are present.

It is desirable that herbarium specimens all over the country under the above names be re-examined to look for *A. capillipes*, to determine the geographical limits of this rather rare Sino-Japanese fern in India.

Acknowledgement

We are grateful to Prof. T. Reichstein (Basal, Switzerland) for help with the identification of *Asplenium capillipes.*

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30. ON THE IDENTITY OF *HEDYOTIS SILENT-VALLEYENSIS* (RUBIACEAE)

Hedyotis silent-valleyensis Vajravelu *et al.* in *J. Bombay nat. Hist. Soc. 80*(2): 409. 1983 [1984] is described on the basis of two gatherings *H. T. Vajravelu* 27674 & 48857 collected in 1966 from Kunthipuzha, Silent Valley, Palghat District, Kerala State. Illustrations of fig. 4a & 4b are erroneous as the immature fruit (fig. 4a) cannot be broader than the mature one (fig. 4b) and that the part of the calyx tube, produced above the ovary is not depicted on the mature fruit (fig. 4b).

A study of the protologue suggests that the authors attempted to establish affinity with a distant taxon — *H. purpurescens* — which shows differences. On the other hand, it agrees with *H. bourdillonii* (Gamble) Rolla Rao & Hemadri. It is interesting to note that *H. bourdillonii* has been recently reported by Nair *et al.* in *Bull. Bot. Surv. India 22*: 205, 1980 after 120 years of its original discovery from the same locality from which the new species has been collected. In consideration of these facts it does not stand as a distinct species and deserves to be treated as a synonym as follows:

Hedyotis bourdillonii (Gamble) Rolla Rao & Hemadri in Ind. For. 99: 378. 1973; Nair *et al.* in Bull. Bot. Surv. India 22: 205. 1980. *Oldenlandia bourdillonii* Gamble in Kew Bull. 1919: 404. 1919 & Fl. Pres. Madras 2: 598. 1921 (Type: Travancore, 1857, *Bourdillon* 111 K photo ! iso. MH !, duplicate ! CAL).

H. silent-valleyensis Vajravelu, Rathakrishnan & Bhargava in *J. Bombay nat. Hist. Soc. 80*(2): 402. 1983 [1984] (Type: Kerala, Palghat District, Silent Valley, Kunthipuzha, 1966, *H. vajravelu* 27674 ! holo. CAL, iso. MH) & *H. vajravelu* 48857 ! (para MH), synon. nov.

Botanical Survey of India,
Howrah,
February 12, 1985.

D. B. DEB
RATNA DUTTA

31. NOTES ON THE DISTRIBUTION OF RARE AND LITTLE KNOWN *CAREX LIGULATA* NEES FROM NORTH-WEST HIMALAYA

(*With a text-figure*)

Carex ligulata Nees (Cyperaceae) was previously collected by Royle (1839), from the Himalayan region. Since then for over one and half centuries there is no record on the distribution of this species from North-West India, specially the Himalayan region. Recently, the species has been collected by us from an interior part of Garhwal Himalaya. The species is easily distinguished from its allies by a single terminal male spike and stem covered with leaf sheaths. The plant has fodder and local medicinal value in this area.

In the present text, a note on the distribution with a concise discription, figures of some parts (Fig. 1) of this species has been incorporated. The specimen has been deposited by us at Botanical Survey of India, Northern Circle, Dehradun (BSD) and Garhwal University Herbarium (GUH) at Garhwal University, Srinagar Garhwal.

Carex ligulata Nees Hook. f. in FBI. 6: 747 (1894); is a glabrous nearly smooth annual herb. Root stock woody and short. Stem simple, 30-40 cms. in length and covered

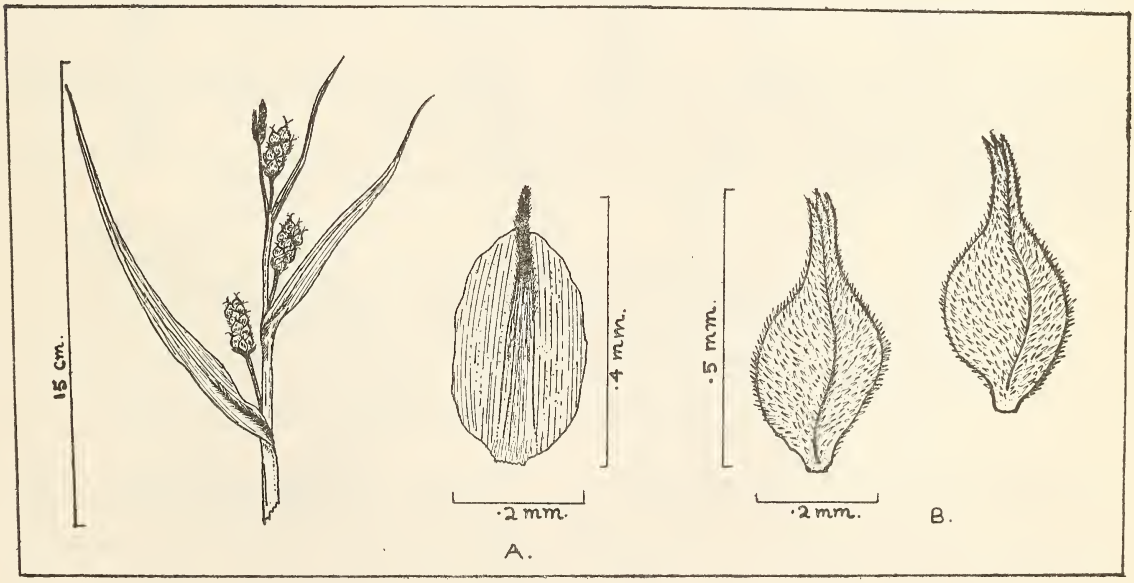
15 cm.
·4 mm.
·2 mm.
A.
·5 mm.
·2 mm.
B.

Fig. 1. *Carex ligulata* Nees: A. Single glume; B. Utricle.

throughout the length with leaf sheaths. Leaves grass-like, flat, striate. 3-4 mm wide. Lower leaves short, those springing from middle of the stem are about as long as inflorescence. Sheaths and leaves (partly) hairy. Female spikes. 3-6 cylindric, distant, 1-1.5 cms. erect on short peduncles, pale coloured. Terminal one male spike slender, 0.8-1.5 cms. brown coloured. Style 3-fid, female glumes ovoid acute, shorter than utricle. Utricle densely hairy, ovoid, triangular, acuminate into short 3-fid beak, 3 mm in length (beak included).

Flowering: Aug.-Sept., *Fruiting*: Sept.-Oct. (GUH Herb 6350).

Distributional notes: *Carex ligulata* Nees was previously reported from Western Himalaya (Kumaon and Kashmir at an elevation range of 5-7000 ft.) by Royle 1839, Falconer (*see* Hooker 1894), Duthie 1906. During a recent collection in Sept. 1984, this species was collected from Binsar valley (Sundergaon Gadhera) of Raath area (District Pauri) in North-West Himalaya at the elevation of 2000 m. The plant was found growing on open sunny places of Paddy and *Eleusine coracana*. Crops of wet Paddy field sides.

ACKNOWLEDGEMENTS

We are thankful to the authorities of BSI, Northern Circle, Dehradun for Herbarium consultation and to Dr. (Mrs.) N. Ghyldiyal for the help in identification of the plant. One of us (RAS) is thankful to Deptt. of Environment, New Delhi for financial assistance.

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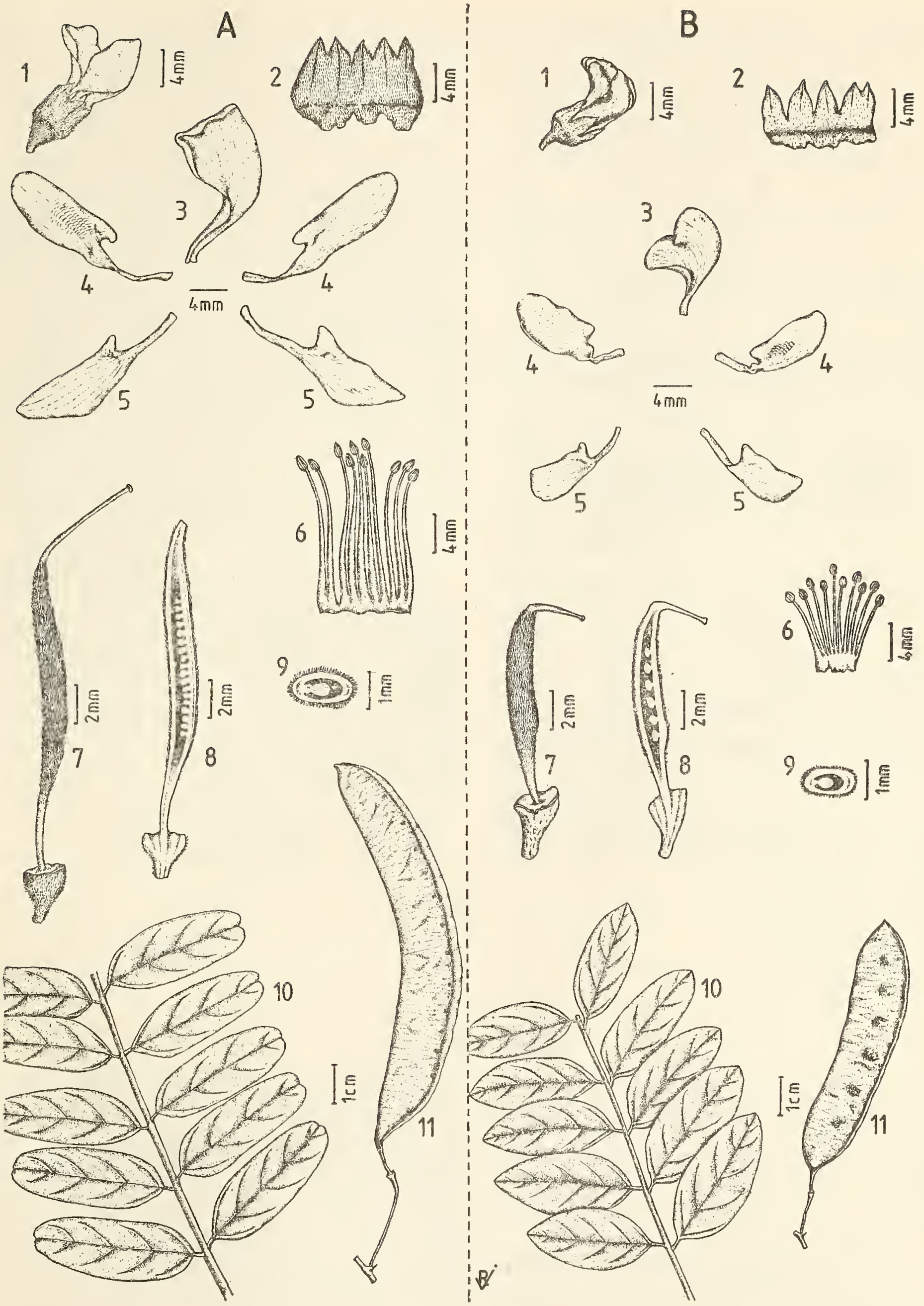
32. *CALPURNIA AUREA* (AITON) BENTH. SSP. *AUREA* (PAPILIONOIDEAE) IN TAMILNADU CARNATIC, A NEW RECORD

(*With eleven text-figures*)

Brummitt (1967) treated the Indian component of the widespread African species under ssp. *indica*, a position followed in (THE FLORA OF THE TAMILNADU CARNATIC series (Matthew 1981, 1982 & 1983).

On further study, however, seven collections RHT 1565, 2873, 7456, 13610, 22476, 28956 (RHT), all from Yercaud, showed significant differences from ssp. *indica*. Brummitt confirmed that two of these collections (RHT 7465,



Figs. 1-11. (A) *Calpurnia aurea* (Aiton) Benth. ssp. *aurea* (1-9 from RHT 1565; 10 & 11 from RHT 13610); (B) *Calpurnia aurea* (Aiton) Benth. ssp. *indica* Brummitt (1-9 from RHT 2940; 10 & 11 from RHT 18901).

1. Flowers; 2. Calyx, opened out; 3. standard; 4. wings; 5. keels; 6. stamens, spread out; 7. pistil; 8 & 9. ovary, l.s. & t.s.; 10. leaflets; 11. pod.

13610) which he examined, really belong to ssp. *aurea*. This leads to the obvious conclusion that at the hill station of Yercaud, Salem Dt., ssp. *aurea* had been introduced in plantations, while in the rest of the area, the native ssp. *indica* occurs.

A key, with an illustration, to distinguish ssp. *aurea* from ssp. *indica*, along with a detailed description of the former, are given below.

Calyx-lobes shorter than the calyx-tube. Standard petal and staminal column 2 cm long. Ovules 12-15. Leaflets distinctly retuse at apex .... ssp. *aurea*
Calyx-lobes equalling or exceeding the calyx-tube. Standard petal and staminal column less than 1.2 cm long. Ovules 6 or 7. Leaflets distinctly acute at apex .... ssp. *indica*

It should be noted that the illustrations (Matthew, K. M. 1982) and description (Matthew, K. M. 1983) are a mixture of ssp. *aurea* and ssp. *indica*.

Calpurnia aurea (Aiton) Benth. Comm. legum. gen. 26. 1837; ssp. **aurea** Brummitt, Kirkia 6: 128. 1967.

Shrub or tree to 4 m; branchlets spreadingly pubescent. Leaves odd-pinnate, 13-20 × 4-6 cm; leaflets 11- 13- paired, (sub) opposite or nearly alternate, oblong-elliptic, inequilateral, chartaceous, 2.5-4.5 × 1.5-2 cm, appressed-pubescent, base oblique, somewhat truncate-obtuse, apex obtuse, distinctly refuse, obscurely mucronulate; stipules subulate; stipels 0. Racemes spreadingly pubescent, axillary, 18-25 cm, 30-40 flowered; bracts small; bracteoles obscure; pedicels 1.5-2.5 cm, slender. Calyx-tube broadly campanulate, 6-9 mm; lobes 5, shorter than tube; upper lobes fused. Corolla yellow, exserted; standard suborbicular, 2 × 1 cm, with a claw channelled and limb reflexed, cleft at apex; wings to 2.5 × 0.8 cm, sculptured on the outer surface; keels nearly equal to wings, slightly incurved. Stamens 10, free or very shortly united at base, to 2.5 cm. Ovary to 2.5 cm, densely, pubescent; ovules 12-15; perigynous zone 3-4.5 mm; style 6-8 mm, glabrous; stigma capitate. Mature pods stalked, linear-oblong, 7-11 × 1.5-1.8 cm, flat, with a 2 mm wide wing on dorsal suture; seeds compressed, ovoid, 7-10.

Occurrence: Yercaud, 1500 m; in plantations and around.

Flowers: March-May (July).

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33. DISTRIBUTIONAL NOTE ON SOME INDIAN SEDGES

While working on the family Cyperaceae in the herbaria of Forest Research Institute, Dehra Dun (DD) and Botanical Survey of India, Dehra Dun (BSD), a few sedges with doubtful identity were noticed. A critical study of these and a perusal of relevant literature resulted in finding new distributional areas for the following sedges.

1. **Carex curta** Gooden.

This sedge is wide spread in N. America, extra-tropical S. America, Eurasia and S. E. Australia (Kern and Nooteboom 1979). In India, it has been reported from Kashmir (Clarke 1894, Stewart 1967, 1972) and Himachal Pradesh (Wadhwa and Chowdhery 1984). A specimen collected from Uttarkashi was identified as *C. curta* and forms a new record for Uttar Pradesh.

Exsicc. Uttar Pradesh, Uttarkashi, Tapoban, 4200 m, 3.9.1983, *Bhattacharyya* 74806 (BSD).

2. **C. nigerrima** Nelmes

This species was first described on the basis of collection made from Jammu and Kashmir (Nelmes 1940) and is also known to occur in Pakistan (Stewart 1972). A specimen from Lahul in DD herbarium was identified as *C. nigerrima* and is reported here as a new record for Himachal Pradesh.

Exsicc. Himachal Pradesh, Lahul, 3351 m, 2.8.1941. *Bor* 15558 (DD).

3. **Kobresia macrantha** Boeck.

The type of the sedge comes from Nubra in Jammu and Kashmir (Boeckeler 1888). In recent years it has also been reported from Nepal (Koyama 1978) and Pakistan (Stewart 1972).

During the present work, two specimens from Lahul and Spiti were identified as *Kobresia macrantha* which form new records for Himachal Pradesh.

Exsicc. Himachal Pradesh, Lahul, Bara Lacha La, 4800 m, 248. 1970, *Bhattacharyya* 40828 (BSD), Spiti, Shetiger, 4300 m, 25.7.1972, Bhattacharyya, 48858 (BSD).

ACKNOWLEDGEMENTS

I thank Dr. U. C. Bhattacharyya, Deputy Director, Central National Herbarium, Howrah for encouragement and Dr. R. R. Rao, Deputy Director, Botanical Survey of India, Dehra Dun for facilities.

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34. *COLYSIS POTHIFOLIA* (HAM. EX D. DON) H. ITO (POLYPODIACEAE) FROM NAINI TAL — NEW RECORD FOR NORTH-WESTERN HIMALAYA

The fern flora of North-Western Himalaya has been studied by a number of Botanists during the last one hundred years (Clarke 1880, Beddome 1883 & 1892, Hope 1904, Duthie 1906, Mehra 1939, Stewart 1942 & 1945, Dhir 1980, Bir *et al.* 1983). While in Kumaun Himalaya, a good deal of work on ferns has been done in recent years (Loyal & Verma 1960, Pandey 1972, Verma & Khullar 1980, Pangtey *et al.* 1982). During the course of preparation of the Pteridophytic flora of Naini Tal, some interesting specimens of a fern were collected, which were identified as *Colysis pothifolia* (Ham. ex D. Don) H. Ito. The identification was confirmed by Dr. R. D. Dixit, Regional Botanist, Botanical Survey of India, Central Circle, Allahabad. A perusal of earlier literature and herbarium records indicate that this species has not been reported by earlier workers from North-Western Himalaya being known so far from Nepal, Bhutan, Meghalaya, Burma China, Philippines, Korea and Japan. The present collection extends its distributional ranges further west to Kumaun Himalaya. The present collection of this species from Naini Tal (Kumaun Himalaya) is an important addition to the fern flora of North-Western Himalaya. A brief description of the species along with other relevant informations is provided in this note.

Colysis pothifolia (Ham. ex D. Don) H. Ito, Journ. Jap. Bot. 11: 89, 1935; Baishya et Rao, Ferns & Fern Allies Megh. St. India 57-58, 1982. *Hemionitis pothiflora* Ham. ex D. Don, Prodr. Fl. Nepal 13, 1825. *Polypodium ellipticum* Thunb., Fl. Jap. 335, 1784. *Gymnogramme elliptica* Hook. et Baker, Syn. Fil. 389, 1867; Clarke, Trans. Linn. Soc. ser. 2 (Bot.) 1: 570-571. 1880. *Selliguiea decurrens* Presl. Bedd. Ferns. Brit. Ind. t. 150, 1867.

Rhizome thick, wide creeping, densely scaly. Scales lanceolate, blackish, clathrate. Stipe 10-30 cm or more, slender, glabrous, erect, straw coloured, 17.5-38 cm long. Fronds 22-30 cm long, 12.5-22 cm broad, cordate-lanceolate, pinnatisect, segments 3-5 on each side under the terminal segment (10-14 cm long and 1-2.7 cm broad) similar to lateral ones hardly reduced, entire, mostly connected by decurrent bases giving winged appearance. Texture herbaceous, intermediate veinlets anastomosing copiously. Sori linear, appressed along lateral veins, oblique to costa, Sporangia globose, dark-brown. Spore oval to elliptical hyaline, light brown.

Ecology: Rare but locally common growing both lithophytically and terrestrially along the banks of perennial streams in dense miscellaneous forests at 1,300 m near Jeolikote.

Specimens examined: Naini Tal, Jeolikote at 1,300 m (YPSP 208, 209).

ACKNOWLEDGEMENTS

We are grateful to Dr. R. D. Dixit, Regional Botanist, Botanical Survey of India, Central Circle, Allahabad for the confirming our identification. Thanks are due to Head, Botany Department, D. S. B. College, Kumaun University, Naini Tal for providing necessary facilities.

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August 12, 1985.

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G. S. RAWAT
S. S. SAMANT

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VERMA, S. C. & KHULLAR, S. P. (1980): Ferns of Naini Tal (Western Himalaya): an updated list. *Fern Gaz. 12*: 83-92.

35. *OXYTROPIS SERICOPETALA* C.E.C. FISCHER (FABACEAE) — A NEW RECORD FOR INDIA

During the course of identification of some plants received from Forest Department, Himachal Pradesh we came across an interesting specimen of *Oxytropis* which on critical examination has been identified as *Oxytropis sericopetala* Fischer, a species so far known only from Tibet in China. It is now being reported for the first time from India.

Oxytropis sericopetala C.E.C. Fischer in Kew Bull. 1937: 95. 1938.

A tufted herbaceous perennial. *Stem* grey, wooly. *Leave* pinnately compound, 7-20 cm long, petiole 4-8 cm long with silvery rachis; leaflet 10-15 pairs, sessile, 6-21 × 2-4 mm, covered with fine silky hairs on both surface. *Stipule* lanceolate, acuminate, ± 5 mm long, silvery tomentose. *Peduncle* axillary, 4-20 cm long. *Spike* dense, 5-10 cm long, bracts linear, 2.5 mm long, villous. *Flower* sessile. *Calyx* silvery villous, tubular, 4.5 mm with five subequal linear ensiform, 5.5 mm long teeth. *Corolla* much exserted, blue-purple, 10-12 mm long with 9-10 cm long lateral rounded lobe, keel 7-8 mm long. *Stamen* 10, diadalphous. Ovary shortly stipitate, 4 mm long, villous.

Specimens examined:

Near kaza Spiti (Himachal Pradesh) 5800 m, 1.7.1953, *R. C. Kaushik* 1060 (DD); Hill behind Gyantse (Tibet) 4500 m, 3.8.1936, *F. Spencer Chapman* 1019 (DD).

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Dehra Dun,

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Lucknow,
July 17, 1985.

H. B. NAITHANI
SUMER CHANDRA

B. S. ASWAL

36. *THELYPTERIS PALUSTRIS* (SALISB.) SCHOTT. — NEW RECORD FOR U.P. HILLS

During an extensive plant collection in Kumaun region of western Himalaya, we collected *Thelypteris palustris* (Salisb.) Schott. from Deochula and Sandeo near Didihat. The recent collection of this plant is interesting from phytogeographical point of view since there is no record of it from U. P. hills. Thus, its occurrence in Didihat locality of Pithoragarh District (Kumaun) extending its eastward limit of distribution. However, it has been reported from North India (Kashmir and Himachal Pradesh); South India (Nilgiris, Ootacamund); Europe, North Asia, North America and New Zealand. The Voucher specimens are housed in the Herbarium, Department of Botany, Kumaun University Campus, Almora.

Thelypteris palustris (Salisb.) Schott., Gen. Fil. ad. t. 10, 1834; Ching, Bull. Fan. Mem. Inst. Biol. 6: 330, 1936; Khullar, Sharma & Singh, Nova Hedwigia, 38: 660, 1983; Dhir, Ferns North Western Himalayas, 100, 1980. *Lastrea thelypteris* (Linn.) Bory, Dict class 9: 233, 1826; Bedd., Handb. Ferns Brit. India 241, 1883 (excl. plants from South India). *Nephrodium thelypteris* (L.) Strempel, Fil. Beol. Syn. 32, 1822; Clarke, Trans. Linn. Soc., 2. Bot. 1: 517, 1880; Hope, Jour. Bomb. nat. Hist. Soc. 14: 727, 1903, *Dryopteris therypteris* (L.) A. Gray, Man., 630, 1848.

Rhizome long creeping, thin. Stipe upto 40 cm long, Stramineous, glabrous. Rachis stramineous, sparsely hairy. Lamina 1-pinnate, upto 70 × 20 cm., both surfaces sparsely hairy; pinnae many 20-30 pairs, sterile pinnae larger than fertile one, fertile pinnae distant, sterile close together; lower 1-2 pairs of pinnae a little reduced but never strongly; viens 6-8 pairs, free; costae hairy sori indusiate, small submedial; indusia light brown, reniform, hairy, with wavy margin. Spores perinate spinulose, bases of spines close together resulting in reticulatum.

Specimens examined: Kumaun Himalaya, District Pithoragarh, Deochula (1900 m), P. C. Pande 17816 dated Oct. 1984; Sandeo (1860 m), M. M. Kandpal 179 dated 30.9.84.

Ecology: Grows in shady and wet places along perennial water courses inside *Quercus* forests.

Acknowledgements

Grateful thanks are due to Dr. S. P. Khullar, Department of Botany, Panjab University, Chandigarh for confirming the identity of the taxon and also to Dr. G. C. Joshi, Head Botany Department, Kumaun University, Almora for providing facilities.

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June 21, 1985.

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37. USE OF SELF-TINDERING *CORDIA* FIRESAWS BY THE BAIGA IN THE MAIKAL HILLS

(*With a text-figure*)

During zoological fieldwork in Kanha Tiger Reserve, Madhya Pradesh (22° 17′N, 80° 38′E), indigenous methods of firemaking by the Baiga forest tribe (Elwin 1939) were recorded. Although matches were commonly used, 'steel & flint' and firesaw methods persisted. The latter, locally called 'gursa', were usually made from branchlets of "lusari" (*Cordia myxa, Cordia latifolia*; Boraginaceae), a use not previously recorded for these species (Brandis 1874, Witt 1916). Brandis (1874) describes *Cordia* as soft, porous wood making excellent fuel. The procedure used in the manufacture of a 'gursa' was as follows (Mungal Baiga pers. comm.). A 12″ segment of dead *Cordia* branch, 1″ diameter, was cut from a bush/small tree with a 'kulhari' or 'pursa' light axe. Once stripped of any bark the piece was split longitudinally, forming two halves, one becoming the base, one the saw (*see* Fig. 1). A 2 – 3″ long longitudinal split was made at one end of the base, wedged open with a $\frac{1}{2}$″ wide pebble or twig. The base was placed upon a boulder or fallen tree and held, at the end

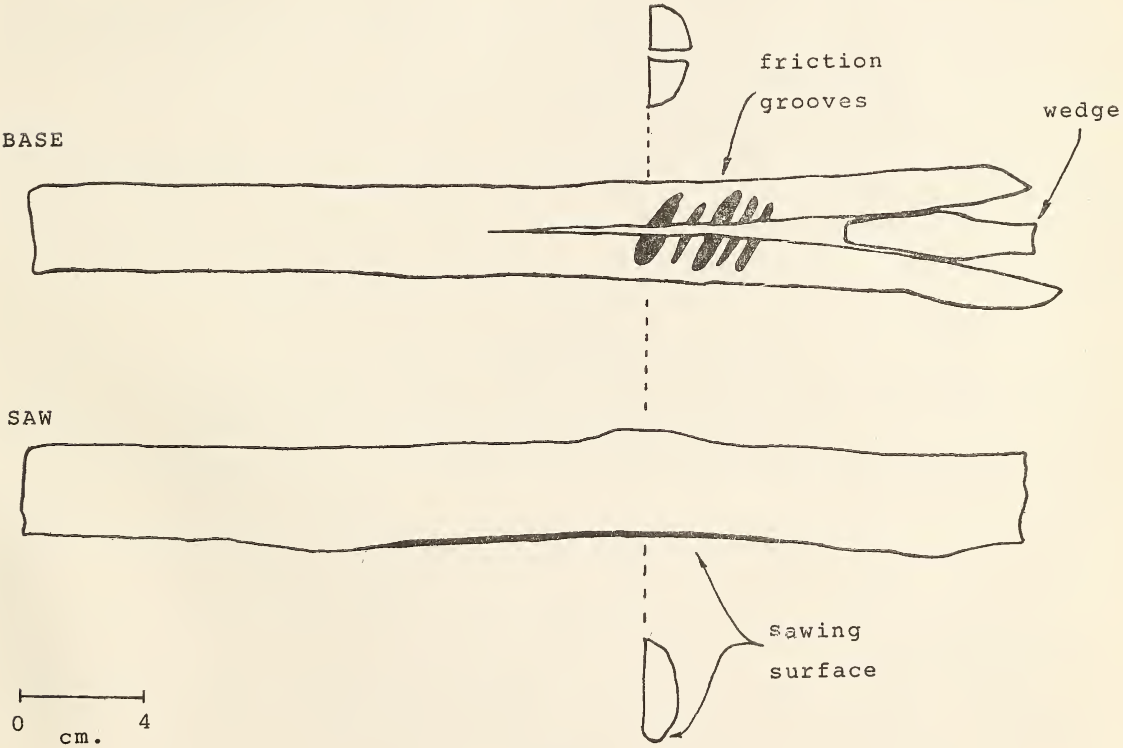

Fig. 1.

farthest from the notch, by the foot of a flexed leg. The operators body was stabilized by the extended opposite leg. The saw was held firmly, with a hand at each end, and its sharp edge stroked transversely across the notch which was floored by a dead leaf inserted between gursa and boulder.

With considerable vigour and downward pressure on the saw, it was repeatedly scoured across the base, a wisp of smoke appearing within some 10 strokes. The friction grooved the base, causing fine wood particles from both saw and base to collect in the notch. The leaf floor prevented the particles from falling out of the notch. The groove, some 0.4″ deep, blackened and smouldered with the heat of friction and ignited the heap of dust. Judicious blowing and application of kindling or a 'bidi', lit a fire or cheeroot respectively. However, up to five attempts were required for successful ignition. The firesaws were discarded after use.

Elwin (1939) described firedrills and firesaws among the Maikal Baiga, but the apparatus was, unlike here, used by a pair of operators. Additionally, bamboo (presumably *Dendrocalamus strictus*) was used, requiring tinder of dry leaves or *Bombax malabarica* 'cotton'. In Kanha, *Cordia* was almost exclusively used, bamboo was utilized in the hill area but regarded as inferior for fire making. The *Cordia* method has the advantage, unlike bamboo, of generating sufficient of its own tinder for ignition.

A 'gursa', with slides illustrating its manufacture, has been deposited with the Pitt-Rivers Museum, Oxford. I thank Mungal & Mohan Baiga for their information, the Madhya Pradesh Forest Department for assistance and B. A. L. Cranstone and Maggie Birkhead for advice. The Jt. Sec. (Wildlife), New Delhi, Chief Wildlife Warden (Bhopal) gave permission for fieldwork. The project was funded by the SRC (UK).

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May 5, 1985.

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